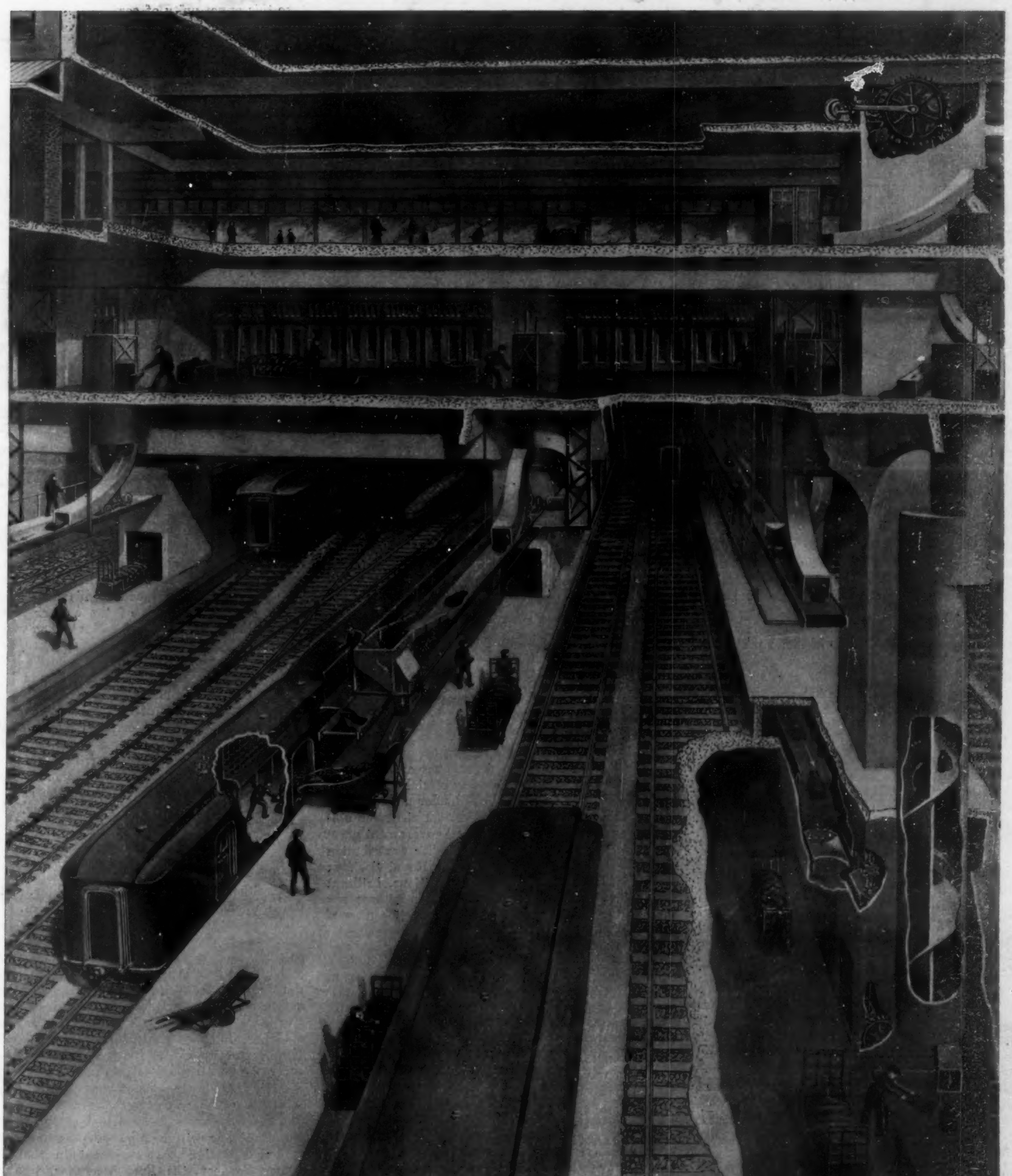
SIXTY-SEVENTH YEAR

SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

VOLUME CIV. NUMBER 5 | NEW YORK, FEBRUARY 4, 1911 | 10 CENTS A COPY $3.00 A YEAR



The machinery that handles the mail at the Pennsylvania Railroad Terminal in New York.—[See page 110.]

SCIENTIFIC AMERICAN

Founded 1845

NEW YORK, SATURDAY, FEBRUARY 4, 1911

Published by Munn & Co., Incorporated. Charles Allen Munn, President; Frederick Converse Beach, Secretary and Treasurer; all at 361 Broadway, New York

Entered at the Post Office of New York, N. Y., as Second Class Matter

Subscription Rates

Subscription one year $3.00
Postage prepaid in United States and possessions, Mexico, Cuba, and Panama
Subscriptions for Foreign Countries, one year, postage prepaid, 4.50
Subscriptions for Canada, one year, postage prepaid, ... 3.75

The Scientific American Publications

Scientific American (established 1845) . . . . per year, $3.00
Scientific American Supplement (established 1876) . " " 5.00
American Homes and Gardens . . . . " " 3.00
The combined subscription rates and rates to foreign countries, including Canada, will be furnished upon application.
Remit by postal or express money order, bank draft or check.
Munn & Co., Inc., 361 Broadway, New York.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

The purpose of this journal is to record accurately and in simple terms, the world's progress in scientific knowledge and industrial achievement. It seeks to present this information in a form so readable and readily understood, as to set forth and emphasize the inherent charm and fascination of science.

Larger Ships—Longer Piers

THE War Department may as well try to stem Niagara or set back the clock, as to prevent the extension of the steamship piers of the city of New York a little farther into the Hudson River to provide suitable accommodation for modern steamships. The jealous care with which the army engineers protect the public waterways against private encroachment is one among many commendable evidences of the unshakable fidelity with which this fine body of men has ever fulfilled its trusts. The soundest principles, however, may sometimes be too rigidly applied. We believe this matter of pier extension is a case in point. To set a limit upon the length of the New York piers is arbitrarily to set a limit to the steadily increasing size of the ocean steamship. This would be to arrest a material development which is taking place in accordance with a broad fundamental law that underlies the whole question of transportation, whether on land or sea.

If the motives which prompt the construction of such giant ships as the "Olympic" and "Titanic" were merely of a spectacular or advertising character, the War Department might be justified in its refusal; very properly holding that the interests of the public in a great national fairway are a vastly superior consideration to the mere commercial rivalry of a few steamship companies. The secret of the large ship, however, lies much deeper than this. It is due to the fact, well understood by all students of transportation, that the larger the single unit, whether it be freight car, motor truck, or river or ocean steamship, the smaller the cost of transportation of a given number of passengers or bulk of freight. To this, in the case of the steamship, may be added the important fact that the larger vessel is always the more comfortable and ever the more proof against disaster.

A few years ago, when the "Lusitania" was making her early voyages, the writer happened to be a fellow passenger with the builder of that famous ship, who was making the trip for observation of her performance. In reply to a question as to whether the expected advantages due to the great size of the vessel had been realized, the answer was given that the results had exceeded expectations, and that if the piers and channel depths were available, the orders for new ships of the largest dimensions would specify a minimum size of one thousand feet.

Had Nature drawn the lines of New York harbor upon a less generous scale, the objections of the War Department to 900-foot piers would be more to the point; but, as we have shown elsewhere in this issue, among the five principal ports of the world, in respect of the width of its fairway and the ample room for the maneuvering of ships of large size, New York stands in a class by itself. As a matter of fact, the new piers could be made one thousand feet in length on the Manhattan side of the river, and still leave a width between opposite pierhead lines that would be over 25 per cent greater than the width of the next largest channel among the leading ports, that of the River Mersey at Liverpool.

The Need of Fog Investigations

ANYONE who has experienced a genuine "London particular," with its paralyzing effects on everybody and everything except the gas and electric lighting companies, realizes how important a part is played by fog in the economy of the world's metropolis. In fact, throughout the British Isles the problem of fog is a serious one, and British meteorologists have accordingly paid much attention to it.

Some years ago the editor of Symons's Monthly Meteorological Magazine undertook to compute the expense for which London fogs were responsible during a single season. On a single day of heavy fog, one of the London gas companies furnished gas in excess of its normal consumption for that date to the value of $15,000. Adding the payments to other gas companies, extra electric lighting, lamps, damage to goods and vehicles, and the loss occasioned by the suspension of traffic, it was found that the cost of a single day's fog amounted to from $30,000 to $50,000. The corresponding expense for the whole season was put down at approximately $600,000.

Considering the heavy cost of fog to the British taxpayer, it is difficult to understand why the British government has not more liberally encouraged the scientific investigation of this element and experiments directed toward finding the means of combating it.

In 1901 an inquiry into the occurrence and distribution of fog in the London district was begun by the Meteorological Council, in response to an application from the representatives of various electric lighting authorities for special forecasts of fog. The forecasts issued from the Meteorological Office mention the general probability of fog if the meteorological conditions in the south of England are recognized as favorable for its occurrence, but more specific forecasts were desired with reference to London, and, if possible, to parts of London. The London County Council was asked to contribute to the expense of this undertaking, and did so to the meager extent of £250. This amount was expended in the course of the winter of 1901-1902, and the first trustworthy detailed statistics concerning the distribution and frequency of fog in London, and the conditions under which it is formed, were secured and published by the Meteorological Office. The practical results hoped for could not, however, be secured in so brief a period of investigation; and as the County Council declined to make a further grant of funds, the "London Fog Inquiry," as it has since been called, was left "a block in the quarry."

The short-sighted action of the London authorities in this matter is, unhappily, representative of the attitude of English officialdom toward scientific investigation. As a rule, scientific research in England, when it succeeds in getting official recognition at all, is carried on with such slender means as we in America would consider about sufficient for stationery and incidentals. The small government grant is sometimes eked out with a smaller contribution from the British Association or the Royal Society; and the fact that, under such conditions, brilliant results are frequently achieved, bears witness not only to the genius and industry of English men of science, but also to their admirable spirit of self-sacrifice.

Sir Oliver Lodge is quoted as having said, in a recent lecture, that if the British nation would grant £100,000 a year to the universities for experiment, he would apply electricity not only to accelerating plant growth, but to dispersing fog and influencing weather in clouds and rain. The experiments already made in France and elsewhere in the use of Hertzian waves to dispel fog, if not conclusive, are at least encouraging; and several other agencies, such as jets of hot air, have been applied with more or less success to effecting the same purpose within a limited area. The problem is, of course, of world-wide interest; as witnessed by the many accidents constantly occurring on the high seas as a result of fog, to say nothing of the enormous amount of time lost by vessels traveling at reduced speed to avoid such accidents. This subject is therefore a legitimate field of inquiry for every government that has the machinery of scientific research at its disposal, as well as for such non-official institutions of research as the Carnegie and the Smithsonian institutions.

Power from Solar Radiation

AN article which we published in our issue of January 21st on the subject of the direct utilization of the sun's heat seems to have awakened considerable interest among our readers, if we may judge by the correspondence received. This correspondence is published separately in its regular place in the present issue. The communications received are of varied character, and are in part critical. The one which naturally claims first attention is a letter from the author of the paper commented on, Prof. R. A. Fessenden. He draws attention to the fact that Prof. Very in the *London Philosophical Magazine* records the attainment, by direct insolation, of a temperature of 98.5 deg. C. above the shaded surroundings, which is thus very considerably in excess of that quoted in the subtitle of our article. We gladly take this opportunity of correcting this figure. The project which Prof. Fessenden has taken in hand is certainly one of peculiar interest, and the results of his efforts will be awaited by us and many others with much curiosity. It does not seem possible, from the data in Prof. Fessenden's original paper, to draw any positive conclusions. After all, the final, perhaps the only reliable test in such matters, lies in actual experiment on a technical scale. Of the conditions and results of such test Prof. Fessenden has not given sufficient information to enable us to follow in detail what has been actually achieved at the present time. But the general interest of the problem attacked, and the ingenuity displayed by Prof. Fessenden in his efforts to wrest another victory from nature, and to harness in the service of man some of that vast stream of energy which we are allowing to go to waste every day—these stand beyond dispute.

Some Recent Feats of Flying

IT speaks well for the future of aviation as a practical art that the efforts of the airmen are being directed in increasing measure to the accomplishment of feats of a practical nature. Particularly meritorious is the work being done by Glenn H. Curtiss, who recently won the SCIENTIFIC AMERICAN Trophy, and his associates. Curtiss seems to be specializing just now in army and navy work, and the recent flight of Eugene Ely from the aviation field near San Francisco, out over the water to the cruiser "Pennsylvania," where he made a successful landing on her deck, was one of the most difficult and creditable aeroplane performances yet recorded. After luncheon with the officers' mess, he gave a dramatic touch to his achievement by starting from the deck of the cruiser and flying back to the aviation ground. Naval men will appreciate the significance of this performance, as bringing the aeroplane scout a long step nearer that stage of its development at which it can be recognized as a reliable and extremely valuable adjunct of the scouting forces of a fleet.

It is conceivable that conditions may exist when it might be difficult, or not convenient, for the aeroplane to land directly upon the ship; indeed, many naval men consider that it should start from and alight on the water alongside the ship and be lifted aboard by the ship's hoisting gear. In calm or fairly moderate weather, such starts and landings might be made without mishap; but where the sea was rough, or even broken by short, choppy waves, the present type of aeroplane would find it impossible, either to get away from the water, or to come down upon the surface without mishap. At the high speed necessary for rising or landing, the hammering effect of even small waves would be so serious as to wreck the light pontoons or shells which must be attached to the machine. On most of the days of the year, however, the sea would be sufficiently quiet for the purpose; and we note that Curtiss, a few days ago at San Diego Bay, successfully accomplished the double feat of starting and landing, rising to about 100 feet above the water, and after covering a circuitous route, returning and alighting at the very spot from which he started, with his machine in perfect control.

Those of us who believe that among the uses of the aeroplane will be that of passenger transportation, will find encouragement in the flight of Roger Sommer, the French aviator, who recently flew, with six passengers, from Douzy to Romilly and return, covering a distance of thirteen miles, without an accident. When we learn, from the cable accounts, that there was not room for all six passengers, and that two of them "straddled the runners," we begin to realize what hard usage a well-constructed aeroplane may be put to, and we get a hint as to its future passenger-carrying ability.

Sir James Dewar, F.R.S.

Famous for His Researches in Low Temperature Phenomena

By P. F. Mottelay

SIR JAMES DEWAR was born at Kincardine-on-Forth, Scotland, on the 20th of September, 1842, received his education at Dollar Academy and Edinburgh University, and when twenty-nine years of age was married to Helen Rose, daughter of William Banks, Edinburgh.

He had in 1863 been appointed assistant to Sir Lyon Playfair, then professor of chemistry at Edinburgh University, from whom he received the principal part of his chemical training, and in 1868 spent the summer term at the University of Ghent under the celebrated professor Friedrich August Kekulé, continuing a research started at Edinburgh on the oxidation of the coal-tar bases, from which originated the Dewar-Körner theory of the pyridine ring. He is the author of numerous papers covering an unusually wide range of chemical and physical subjects, and is now entitled, among other claims, to the distinction of being the recognized world authority on the constitution of the atmosphere. In 1875 he was appointed Jacksonian Professor of Natural Experimental Philosophy in the University of Cambridge, and he has occupied since 1877 the highly coveted post of Fullerian Professor of Chemistry in the Royal Institution. He has besides been lecturer on chemistry at the Dick Veterinary College, chemist to the Highland and Agricultural Society, as well as examiner in the universities of Edinburgh and London, and is at present director of the Davy-Faraday Research Laboratory.

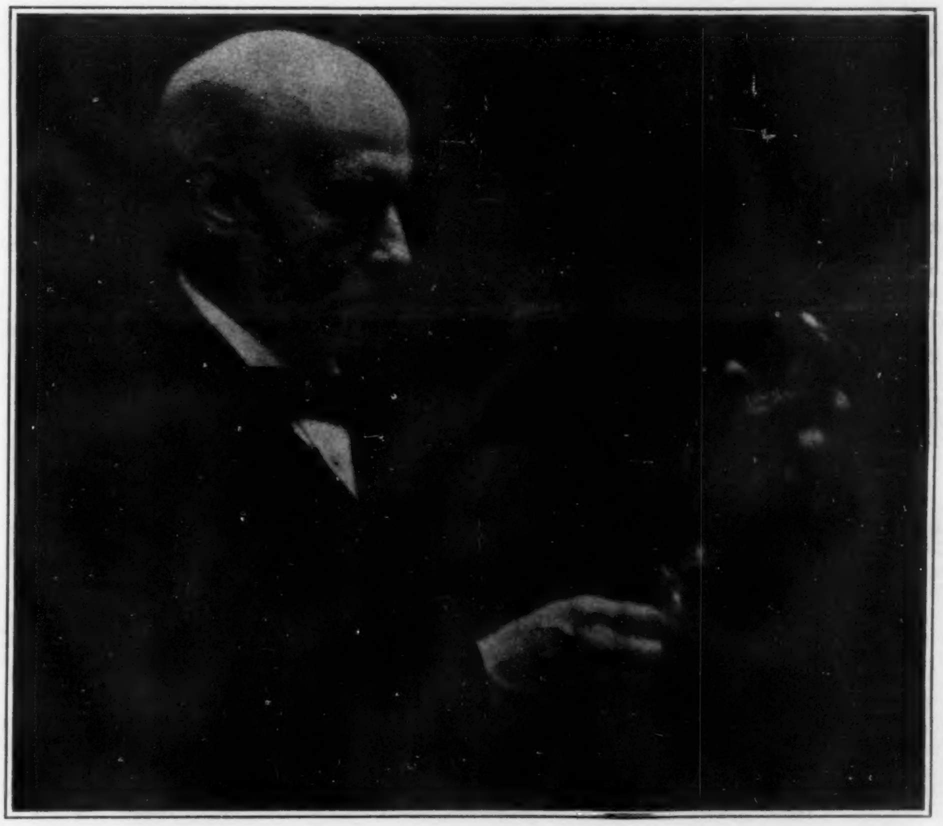
The field of work with which Dewar's name is perhaps more closely linked than any other is that of low temperature research. During the year 1891, on the occasion of the celebration of the centenary of Faraday's birth, he proved among other facts, in a singularly interesting lecture at the Royal Institution, that oxygen, which is known to be but feebly magnetic at ordinary temperatures, becomes highly susceptible to magnetism when subjected to *minus* 180 deg. C. He had previously lectured notably on the "Liquefaction of Oxygen," on the "Chemical Actions of Liquid Oxygen," and on the "Production of Oxygen in the Solid State," and these papers were rapidly followed by others, among which should be singled out those on the "Spectrum of Liquid Oxygen," on "Liquid Atmospheric Air," on "Liquid Nitrogen," on the "Electrical Resistance and Thermo-Electric Powers of Pure Metals, Alloys, and Non-Metals at the Boiling Point of Oxygen and of Liquid Air," on "Electric and Magnetic Researches at Low Temperatures," and on the "Properties of Liquid Fluorine." In the production of the last-mentioned liquid he worked in conjunction with Prof. H. Moissan.

It was for his investigations of the properties of matter at lowest temperatures that the Rumford medal was presented to him in 1894 by the Royal Society, whose president at the time remarked that Prof. Dewar had displayed throughout his researches not only marvelous skill and fertility of resource, but also great personal courage, and that he had not alone succeeded in preparing large quantities of liquid oxygen, but that he had, by his device of vacuum-jacketed vessels, been able to store the liquid under atmospheric pressure during long intervals, and thus to use it as a cooling agent. During his last Friday evening lecture of the 1906 season, Sir James Dewar explained how, with the aid of charcoal, he had been able to make these vacuum-jacketed vessels out of light metals, like copper, nickel, brass, etc., instead of the brittle glass hitherto employed. It is now known that without these peculiar vessels (called Dewar flasks by the scientific world) the crowning achievement of obtaining hydrogen in the liquid state would scarcely have been possible.

In his presidential address to the British Association at Belfast in 1902, Prof. Dewar makes the following reference to the liquefaction of hydrogen, next to helium, the most elusive of all gases: "Compared with an equal volume of liquid air, it requires only one-fifth the quantity of heat for vaporization; on the other hand, its specific heat is ten times that of liquid air or five times that of water. . . . It is by far the lightest liquid known, its density being only one-quarter that of water. . . . It is by far the coldest liquid known. . . . Reduction of the pressure by an air pump brings down the temperature to *minus* 258 deg., when the liquid becomes a solid resembling frozen foam, and this by further exhaustion is cooled to *minus* 260 deg., or 13 deg. absolute, which is the lowest steady temperature that has ever been reached. At this nadir of temperature, air becomes a rigid inert solid. Such cold involves the solidification of every gaseous substance but one (helium) that is at present known to the chemist. . . . As we approach *the zero point* of absolute temperature, we seem to be nearing what I can only call the death of matter. . . . Its existence has long been indicated by the regularly diminishing volumes of gases and the gradual falling off in the resistance offered by pure metals to the passage through them of electricity under increasing degrees of cold. . . . The liquefaction of oxygen and air was achieved through the use of liquid ethylene as a cooling agent, which enabled a temperature of *minus* 140 deg. to be maintained by its steady evaporation *in vacuo*. Liquid oxygen is markedly magnetic, comparing with iron in this respect in about the ratio of 1 to 1,000. It is a non-conductor of electricity, and an induction coil which would give a long spark in the air, failed to pierce a layer of liquid oxygen one-tenth of a millimeter thick."

The remarks made at the Belfast meeting would now, of course, have to be modified by reason of the progress since made with helium, as shown in Sir James's papers (1907), "Studies in High Vacua and Helium at Low Temperatures" and (1909) "Problems of Helium and Radium." In the first-named, he incidentally explained the very slow process of obtaining helium from gas given off by the King's Well at Bath, and alluded to the fact that, in consequence of losing the entire two years' accumulation through the collapse of the glass vacuum vessel containing the regenerator coil, he had to begin all his experiments anew. Notwithstanding this, his researches, though as yet necessarily incomplete, were such as to justify him in predicting the probable properties of liquid helium. Of these, the most important was that the liquid density would be found about 0.14, or at least twice that of liquid hydrogen. Since then this prediction has been closely verified by Prof. Kamerlingh Onnes of Leyden, who has found 0.15 as the experimental value. Sir William Ramsay and Mr. M. W. Travers had inferred with less truth that the liquid density of helium would be 0.43. The critical pressure and general order of constants were what Sir James Dewar suggested, the boiling point being 4 deg. absolute, and the critical point not more than 5 deg. on the absolute scale. The results of direct observations made by Prof. Onnes were: Boiling point, 4½ deg.; critical temperature, 5½ deg. C. absolute; critical pressure, 2½ atmospheres.

One of Dewar's most important discoveries in other fields was that of cordite, made in conjunction with Sir Frederick Abel, who also aided him in developing other explosives accepted by the English government for military purposes. Mention should be made of the fact that he was first to study the very important oxidation products of the quinoline bases, and that much of his attention has likewise been given to the interesting study of phosphorescence.



Photograph by E. O. Hoppé.

Sir James Dewar, F.R.S.

In the accompanying photograph Sir James Dewar is shown holding in his hands a bulb of the type associated with his name. He is of middle height and well built. His strong, clear-cut, refined features and deep-set eyes give him an impressive appearance. Whether seen at the experimental table, on the speaker's platform, or in his magnificent quarters at the Royal Institution, the impression he conveys is one of great earnestness, happily combining the thoughtfulness of the born scientist with the dignity and refinement attaching to his prominent associations and very attractive home surroundings. A strongly individual stamp is given to these latter by a wealth of the very rarest pictures, engravings, Benvenuto carvings, tapestries, scarce books bound in the most sumptuous fashion, etc., which he and Lady Dewar have collected in the course of their travels.

Sir James Dewar's delivery in public is most excellent, and a certain charm is added to his well-modulated voice by a touch of the Scotch accent which he still retains. The preparation of his lectures and reports shows great care and precise method. Indeed, were it not for this, and his propensity for a happy co-ordination of facts, figures, and deductions, the forceful, logical, convincing presentation with which he always appears to impress his hearers, would be impossible. As can be easily realized, it is not an easy task, when treating of the very abstruse subjects he has dealt with, to adapt to the comprehension of the masses the results of explorations made in hitherto unknown paths such as we have called to attention.

His success has been so marked, so extraordinary, of such benefit to mankind, that we must all wish many more days may be spared him to enhance, as he surely will, the admirable work he has already accomplished, leading him to disclose many more of the valuable secrets that Nature guards so jealously.

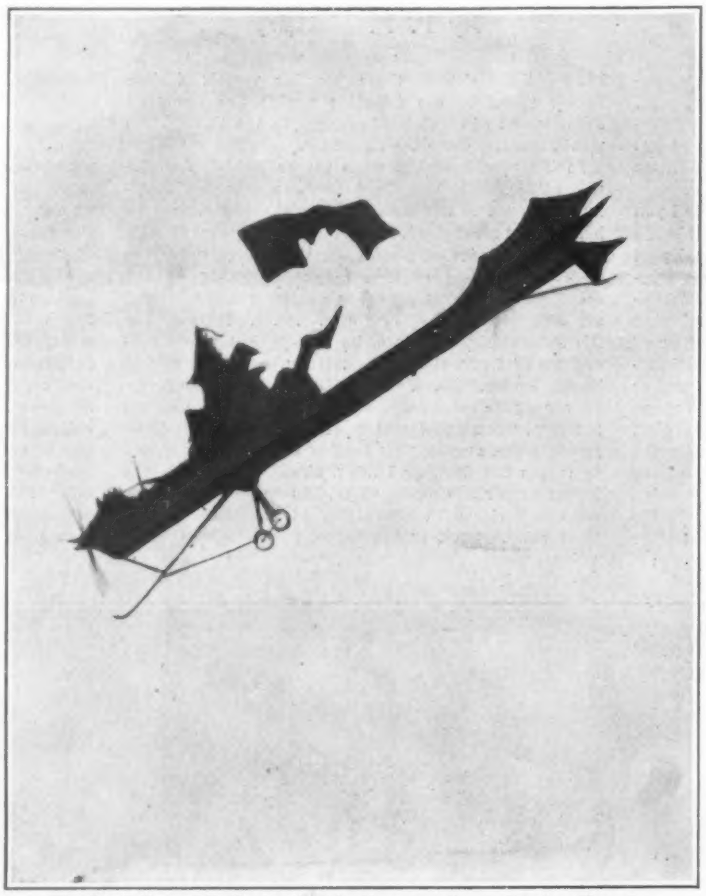
The First Flight from Shore to Ship

How Ely Flew from Selfridge Field Across Country and Landed on the U. S. S. "Pennsylvania"

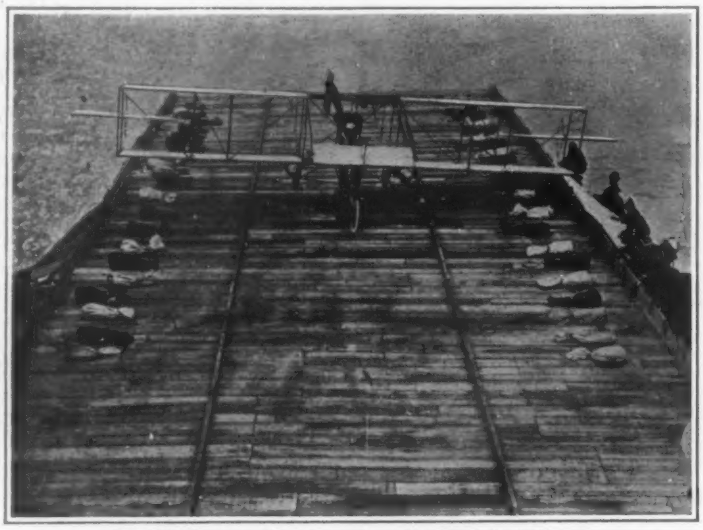
As mentioned in our last issue, Eugene Ely made the first attempt to fly from shore to a warship and alight thereon on the 18th inst. The photographs reproduced herewith show Ely's Curtiss biplane just as it was about to alight upon the special platform and also after it had alighted and was being brought to rest by a score of ropes stretched across the platform above the two rails which ran its entire length. These ropes were attached to sand bags at each end, and they were found to act as an efficient brake in checking the momentum of the machine. Although Ely had floats fitted beneath the lower plane on each side of the center section, this proved to be an unnecessary precaution. He made the flight to the "Pennsylvania," which was anchored amid the dense shipping in San Francisco Bay, in 13 minutes, and arrived upon the warship at three minutes before 11 A. M. In flying the 12 miles from Selfridge field, he had risen to a height of 2,000 feet and passed over the San Bruno mountains. Soon after the start Ely was espied by the sailors in the fighting tops of the warship, a tiny speck above the mountains. The speck grew larger as it rapidly approached and the surfaces of the biplane were outlined against the sky. As it neared the harbor Ely's air craft descended rapidly until, when he flew over the "West Virginia" and the other smaller vessels, he was only 150 to 200 feet in the air. At just the right moment he shut off his motor and glided down to the platform on the stern of the "Pennsylvania." He struck this 32 × 127-foot platform 25 feet from its outer end, which sloped downward 4 feet in 10.

After a reception on shipboard lasting an hour, Ely started from the vessel without any difficulty and flew back to the aviation field again in 13 minutes.

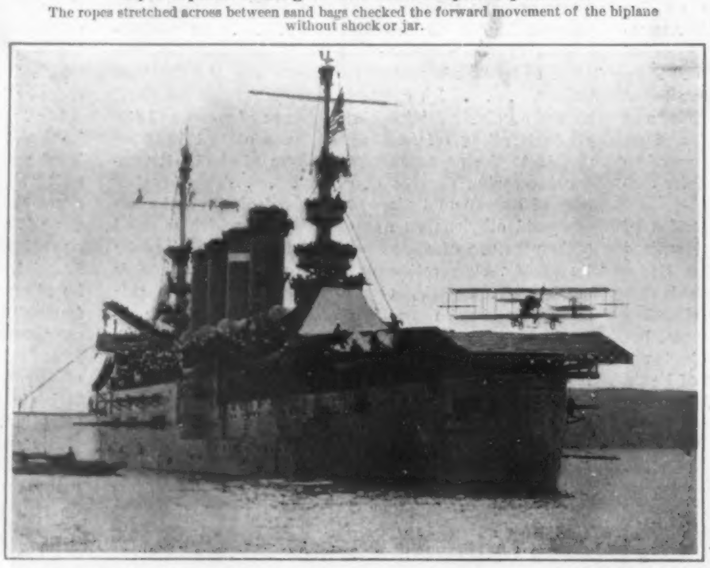
Thus was accomplished the first round trip flight from shore to ship. Ely had previously flown from ship to shore in Hampton Roads last November. In both instances he won a prize of $500 offered by the U. S. Aeronautical Reserve. His excellent flights have increased interest in the aeroplane for naval use and will no doubt help in getting through Congress the appropriation of $25,000 recently asked for by Secretary of the Navy Meyer for experiments in aviation. The success of Glenn Curtiss in rising from the surface of the water in his machine mounted on floats at San Diego on the 26th of January, will also help along the cause of aviation in the Navy.



The fatal dive of Laffont's Antoinette monoplane, showing the wing breaking away. Two men were killed.



Ely's biplane coming to rest on the special platform.
The ropes stretched across between sand bags checked the forward movement of the biplane without shock or jar.



Aviator Ely about to alight upon the "Pennsylvania" after a 12-mile flight.

Recent Fatal Accidents with Monoplanes

Most remarkable is the photograph reproduced on this page of an Antoinette monoplane diving to the ground with its wings breaking off in midair. This accident, which cost two lives, occurred on December 28th, at Issy-les-Moulineux, just as Laffont, the chief pilot of the Antoinette firm, was about to start for Brussels with Senor Pola, a young Spaniard, who accompanied him as passenger. There was a treacherous wind blowing at the time, but this was not sufficiently strong to prevent a flight with an Antoinette monoplane, which is noted for its ability to fly in the heaviest winds. Almost from the start, however, the aviator had difficulty in negotiating the severe and irregular gusts, while the higher he went the worse seemed to be the trouble in which he found himself. He made three circuits of the field before crossing the starting line, and he had just started on his fourth circuit when his monoplane seemed to be caught in an aerial maelstrom. It heeled over, plunged and reared, and then dove to within 100 feet of the ground. Just when Laffont had apparently got control again, one wing broke away and in a final plunge the aeroplane was completely demolished and the aviator and his companion instantly killed.

As in the cases of Wachter and Chavez (the former on an Antoinette and the latter on a Blériot) a wing broke at the end of a swift descent. Apparently the sudden strain brought upon the wing guys when a long swift descent was suddenly checked, taxed these to the breaking point. After Wachter's accident at the Rheims meet last summer the makers of the Antoinette monoplane strengthened the steel-rod guys and added an extra one, but these guys still had the weak point of being in two parts, the ends of which were threaded and connected by a turnbuckle. The threaded part of the rods was naturally much weaker than the remainder, which had a diameter of from ¼ to ⅜ inch, and in all probability the threads stripped and the guys broke under the strains to which they were submitted.

Another aviator who lost his life on December 26th in an accident with a Blériot monoplane was the Italian Picolo. His accident, which is said to have been due to the motor stopping when flying in a strong wind, resulted in a bad smash and such severe injuries to Picolo that he died the next day.

Lieut. Caumont, one of the best French military aviators, also lost his life in testing a Nieuport monoplane on December 30th. Before ascending Lieut. Caumont complained that the control levers did not work easily enough, but being assured by the constructor that they were all right, he took his chances and made a good flight of about 10 minutes duration. Finally something jammed in connection with the controls; the machine tipped to an alarming degree and slid sideways to the ground. The officer had both legs broken and was so badly injured internally that he died in a few hours.

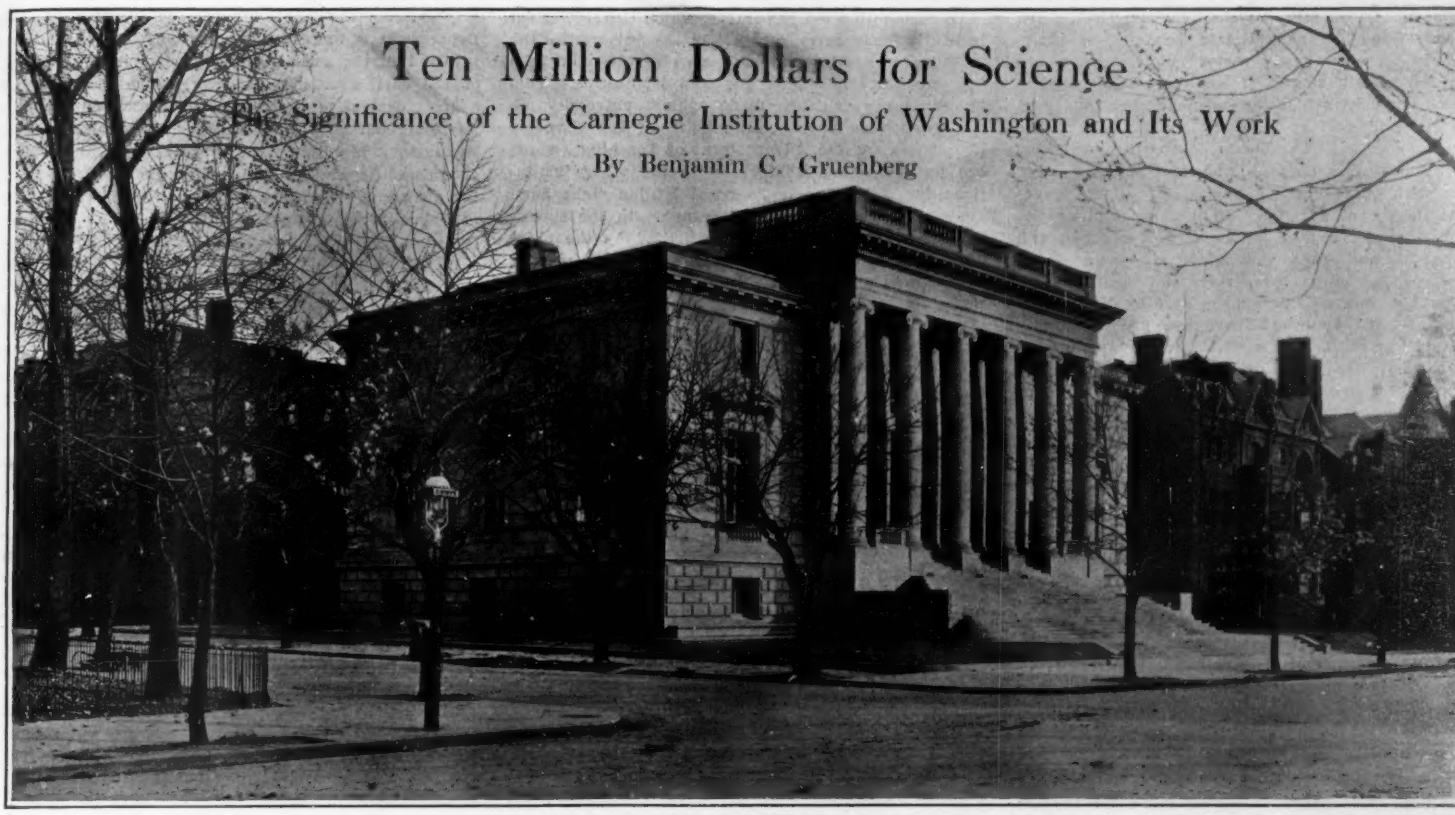
Finally, on the last day of the old year, our best and most fearless aviator —John B. Moisant—was pitched headlong from his Blériot while descending near New Orleans. Mr. Elmer A. Sperry, an eminent electrical engineer of New York city, has put forth the theory that Moisant's accident was caused by gyroscopic force, which so suddenly tilted his machine from the sharp angle of about 60 degrees at which it was descending to one of 90 degrees or more, that the aviator was taken unawares and shot out of his monoplane with great force. Mr. Sperry points out that, supposing the propeller to have a weight of about 35 pounds and to be revolving at 1,000 revolutions per minute, and also taking into account the revolving cylinders of the Gnome motor, it was only necessary that there be a pressure of 48 pounds more against the front of one of the wings at a distance of 8 feet from the body of the monoplane, than against the other, in order to produce a strong gyroscopic force of 1,654 pound-feet that would tend to turn the machine forward through an arc of 120 degrees in a second. Such a slight difference in pressure against the wings could easily be set up by a slight movement of the vertical rudder or by the machine striking one of the so-called "air-holes" that are said to be so numerous. Mr. Sperry believes that the use of a single revolving-cylinder motor and propeller is very dangerous on account of the gyroscopic forces developed.

Just what actually occurred, no one will probably ever be able to tell. When a flying machine which has been crippled reaches the ground, it is such a tangled mass of splintered wood and twisted metal that we must depend upon eye witnesses for what actually happened.

Ten Million Dollars for Science

The Significance of the Carnegie Institution of Washington and Its Work

By Benjamin C. Gruenberg



The Administration Building.

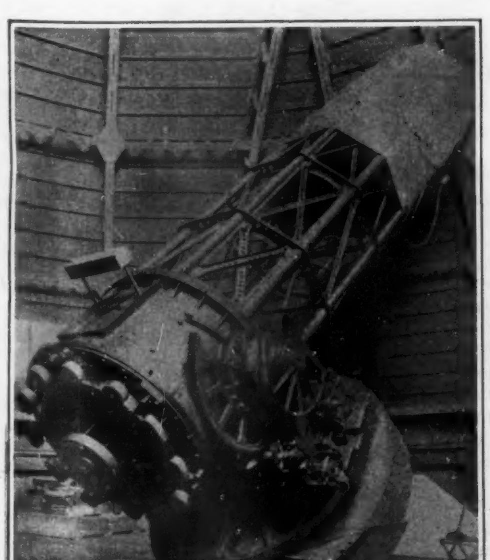
NINE years ago Mr. Andrew Carnegie founded the Carnegie Institution at Washington, a scientific bureau without a parallel in the world. A few weeks ago he added ten million dollars to the original ten million given at the time of the institution's foundation, and to the five million given since then. The total is a larger sum than most of us can conceive. An endowment of twenty-five million dollars means an income to the institution of $2.37½ for every minute of the year, day and night, Sundays and holidays included. And all for Science!

There are two types of mind that marvel at this vast sum, and then wonder that good money should be spent apparently so recklessly. Two types of people there are who do not quite see the use of it. There are those who are oppressed by the consciousness of so much suffering of all kinds that is in crying need of relief, those who see poverty and sickness and the mental misery that follow in their train, the distress that is caused by moral sickness too, and who know how hard it is to abate a fraction of it all without the means; those who see in a large, round sum of money great possibilities in the way of food and fuel and shoes and medicines and comforts and opportunities. And then there are those who flatter themselves that they are "practical" and have no need for theory, those to whom theory means just the impracticable and the ineffectual. To both of these classes science means a certain intellectual luxuriousness, something very nice if we can afford it, but not to be considered as long as there are "real" needs pressing for solution.

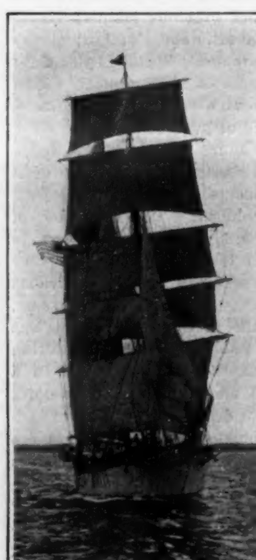
THE PRACTICAL GOOD TO BE DERIVED.

Without denying the existence of dire distress that is in large measure susceptible to relief with the aid of ample funds, and without minimizing the importance of producing "practical" results, the endowment of science may be justified even to the bleeding heart and the busy hand. Modern society has passed so rapidly from the state of individual and hand production to the state of factory and machine production, that some of us have not had time to adjust ourselves to the new modes of life and of labor, and to tear ourselves away from the traditional modes of thought that went with the old forms of production. The mode of life characteristic of the present is the urban mode. The mode of work that is characteristic of the present is the factory mode—the division of labor with technical direction and correlation. The mode of thought that is characteristic of the present is the scientific mode.

Now city life implies conditions of communication, of transportation, of transit, of housing, and of sanitation that are vastly more complex than the generation of our civil war veterans ever dreamt of. The method of the factory implies a comprehensive development of the technology of production which is a tremendous advance over what was even thinkable two generations ago. And the technology of our urban mode of life and the technology of our modern mode of producing raw materials as well as finished articles rest upon a foundation of knowledge—scientific knowledge, knowledge that has been slowly acquired through the systematic efforts of the investigator. "Technology," it has been well said, "is a by-product of science." And that is strictly true. Occasionally a man hits upon a useful combination of materials by accident; in some occupations the rule of thumb still obtains. But the great body of our technical knowledge, the great body of those complex operations that distinguish human action of to-day from that of all past times, has resulted from a deliberate application of scientific principles worked out in the laboratory or the field. The method of hit-and-miss must give way to the method of certain knowledge, not merely because we are competing with other nations in the "markets of the world," and must perforce eliminate from our industries waste and inefficiency. The same need would exist to-morrow if by some means we were completely withdrawn from economic competition. The hit-and-miss method must give way because mankind is becoming very rapidly conscious of the value and possibilities of human living, and is becoming accordingly resentful of everything that is wasteful of human life and human effort. And the hit-and-miss method can be eliminated only as fast as we



The 60-inch reflecting telescope of the Mount Wilson Observatory.



The "Carnegie," a non-magnetic ship.

First section of the 150-foot tower telescope of Mount Wilson.

have scientific knowledge to take its place. If there are diseases to conquer, we shall conquer them when our knowledge of the intimate behavior of protoplasm, in its marvelously varied manifestations, has reached a certain stage. If we are not yet able to raise on our cultivated acres sufficient wheat and wool and corn and beef to feed the hungry and clothe the naked, we shall be able to do so when we know enough about chromosomes and biotypes and other things with queer-sounding names. If we are aware of the danger of a rapidly diminishing fuel supply, we shall be set at ease by studies of sun-spot and wave-motion and other "theoretical" problems. If we suffer from the misery of poverty and ineptitude, we may not get relief of a permanent kind by distributing the millions of the millionaires, but we are more likely to find a way out by getting first the products of some psychological laboratory or of some vast investigation in anthropometry, or other "unpractical" studies.

THE ENCOURAGEMENT OF NEW RESEARCHES.

It is very significant that the earlier endowments of scientific research were confined to assisting physical sciences. It is not to be supposed that all the men whose generosity prompted these gifts were so calculating as to select the physical sciences for special favor because of their more direct applicability to industry. Men like Thompson and Tyndall at any rate were themselves scientists and valued research "for its own sake," as the saying is, however it may have been with men like Smithson or Franklin. The endowment of astronomical research appeared very early in this country, when the question of economic returns were entirely out of the question. But astronomy as an object of university study had a traditional claim upon those who were inclined to give material aid to higher education; and the physical sciences established their claim simply by producing results. The interesting thing about these more recent endowments is the fact that biological and social sciences are getting for the first time an opportunity to receive a free development with the aid of large funds. And if this period of biological research shall be found in later ages to coincide with a large development of man's mastery of the living forces of nature, it will not be because Mr. Carnegie had a shrewd suspicion that the facts about the "Induction of Fasciations" or about "Fossil Cycads" could be turned to account in increasing the wealth of the nation. But Mr. Carnegie and Mr. Rockefeller and Mr. Phipps and Mr. Crocker and many others who have shown more skill in the arts of commerce and finance than in the arts of the laboratory or of the observatory, have come to believe that somehow or other scientific research is worth what it costs—though the cost is high. In a way we have now reached a point at which science seems to be a by-product of finance or industry; but in reality this is only a loan, and it will be repaid a hundredfold.

We must all come to realize that for modern society science is a vital necessity. For advancing science there are needed two factors: free men and special facilities in the way of equipment. Heretofore most of our science research has been carried on in universities. The constant demands that the universities have been making for more and ever more money were made because of the great expense of research rather than because of the expense of teaching. The rapid increase in the endowments for scientific research as well as in the number of institutions devoted especially or exclusively to research has raised the question of whether the universities should not be entirely divorced from this function and left free to devote themselves to teaching. On the one hand is the fact of increased efficiency to be obtained from specialization and concentration of effort. On the other hand are the needs of the universities for men who can teach from direct and intimate contact with the living stream of new knowledge in the process of manufacture, so to speak. There can hardly be any question that science teaching is most effective in the hands of men who are interested in research, other things being equal. But not only in the interests of the universities, but also in the interests of the advancement of science, it is desirable that research be not banished from the teaching institutions. In the first place, it takes an investigator to recognize the special ability for this special work; and we must depend upon the universities to find our scientists for us. If the university men devote themselves to teaching exclusively, they will not find these potential scientists for us. In the second place, the scientist himself needs, at least occasionally, the inspiration and stimulus that comes only from contact with younger minds. While it is desirable to free the man who has the rare gift of discovering the light as far as possible from the drudgery and routine connected with most teaching positions, it is not desirable to separate him entirely from the "stream of youth" or to free him from the necessity of analyzing his own work sufficiently to be able to give to the students an intelligible account of what he is doing.

There is still another point at which the specialized institution may carry danger. In the universities the investigator has been for the most part free to take his own gait and follow his own inspiration. This indeed is the criticism made against university administration in the latest bulletin of the Carnegie Foundation for the Advancement of Teaching (which has no connection whatever with the other institution; for Mr. Carnegie does not let his right hand know what the left hand is doing). In the special institution the worker may be limited by the plans of the administration and the necessity for making a report on a fixed date. We need to guard against wastefulness and inefficiency; but the mind of the investigator may balk at a programme, and that is wasteful too.

Finally this thought occurs to me: Science is a necessity of life for society. To produce it we need men of special ability and certain opportunities. To get it, we depend upon the generosity of wealthy men coinciding with their wisdom to recognize the desirability of subsidizing other men who have the ability to do the work. In the case of other needs of which society has become conscious, we have simply bought our own supplies. We do not wait for the generosity of wealthy men to clean our streets or to take our census or to carry our mails. But that may simply mean that we have not grown in social consciousness as rapidly in one direction as we have in some others.

THE ORGANIZATION OF THE INSTITUTION.

The administration of the institution is in the hands of a Board of Trustees, who elect a president by ballot. The latter holds his office during the pleasure of the Board, and is the chief executive of the institution. The details of management are entrusted to an executive committee and a finance committee, who have control of the distribution of funds to defray current expenses and for endowment of individual research.

The plan which has been adopted by the Institution is to establish centers in different parts of the States, according to the locality best adapted for the particular line of work taken in view. The number of such centers, and the variety of work carried on by them is, even at the present time, very considerable and will no doubt be further increased in the future. To give some idea of the nature and scope of the work carried on we can here only very briefly pick out a few of the most salient features.

The Department of Botanical Research is located at Tucson, Arizona, and is under the guidance of Dr. D. T. McDougal. The object of this choice of location was to secure as far as possible the simplest conditions of plant life, such as they are presented in a comparatively desert climate. Among the subjects investigated we find such topics as The Climatology of American Deserts; Evaporation and Soil Moisture; Conditions of Parasitism; Acclimitization; Root Habits of Desert Plants; etc.

Following the order of arrangement of the Year Book of 1910 issued by the Institution, we may next mention some of the work of the Department of Economics and Sociology. This Department is headed by Prof. Henry W. Farman, of Yale University. Among the monographs published from this center within the past are a number dealing with such matters as The Chinese Immigration; The German Element in the United States; various topics Relating to Agriculture and Forestry; the Mining of the Precious Metals; Manufacture, Transportation, Domestic and Foreign; Money and Banking; the Labor Movement; Social Legislation; etc. The immense importance of studies of this kind will be obvious even to those whose calling in life is most remote from the fields of pure science.

At Cold Spring Harbor, Long Island, is situated a Department which perhaps represents one of the most modern phases in Experimental Science, the Department of Experimental Evolution. The character of these researches might be said to be novel in regard to two features. While it is true that from the very start, in Darwin's own work, experimental methods took a prominent position, yet for many years past, and until very recently, the study of evolution was based rather on the observation of existing material, than on any attempt to modify by experiment in a definite and predetermined manner selected examples of biological material. The extension of such experimental methods to the biological sciences on a large scale is a comparatively recent development, and is approximately contemporaneous with the rise of the second characteristic feature referred to above, namely the introduction of the quantative methods of investigation into biological study. The work at Cold Spring Harbor is under the able direction of Prof. C. D. Davenport, and covers various investigations relating to heredity in animals, plants and man.

Located in a suburb of Washington is the Geophysical Laboratory under the direction of Dr. Arthur L. Day. As the name implies the function of this Department is to investigate the physical phenomena involved in the genesis and past and present history of the earth's crust. The work here has involved a great deal of preliminary investigation of a purely physical character, such as the establishment of a satisfactory high temperature scale, to which reference could be made in subsequent work of investigating phenomena associated with the high temperatures at which certain components of the earth's crust originated.

It is impossible to describe in detail, within the compass of such a short review as our present restrictions permit, all the Departments and Phases of work which come within the scope of the Institution. We must be satisfied with a very brief note, almost enumeration, of the remaining Departments. The Department of Historical Research has investigated and placed on record the most important sources and archives at home and abroad which contain material relating to the history of the United States. The Department of Marine Biology, situated at Tortugas, Florida, has carried out a number of biological researches upon various Marine forms. There is a Department of Meridian Astronomy, the headquarters of which is the Dudley Observatory at Albany, New York, and whose main work hitherto has been spent in the preparation of a general catalogue of the stars. At Mount Wilson is the famous Observatory under the guidance of Prof. George E. Hale, devoted to the study of solar phenomena.

The Chemistry and Physics of Nutrition form the subject of study at the Nutrition Laboratory at Boston, Mass., whose director is Francis G. Benedict. The work has consisted largely in the study of metabolism in man under various conditions of health and disease.

The last Department which we shall mention is one, the basis of operation of which cannot be said to be located at any one place, inasmuch as many of the observations are made on board of a special sailing vessel which has been christened after the founder of the University, the "Carnegie," and which is specially designed free from magnetic effects, to serve as the laboratory in which are being collected the data required for a general magnetic survey. This work is under the care of Dr. L. A. Bauer.

One can hardly form too sanguine estimate of the possibilities of benefits to be derived by our generation and those who come after us from the systematic endowment of scientific research. At the present day probably no thoughtful man is disposed to question the value of science to the community, so long as merely general principles are mentioned. It is only when some specific problem is referred to that we often hear the impatient question, "What is the use of such work?" The man who asks such a question is usually forgetful of the fact that he has in his own mind admitted the truth of the general principle of utility and is merely unable in this particular instance to follow out for himself the complicated network of threads by which *some one particular* problem is linked with the infinity of natural phenomena, the proper understanding of which is so essential for our mastery over nature, and for our very life.

The Mail-handling System at the New Pennsylvania Railroad Station, New York City

By Joseph B. Baker

On Saturday, November 27th, 1910, the Pennsylvania Railroad in New York city, which had been operating partly *via* Hudson River ferries and partly by electric tunnel trains running through the twin Hudson River and East River tubes to its new station in Manhattan, took up the full service at the new terminal. This change required the inauguration of a special post office of adequate size and equipment, and a new building 375 feet square, designed by the architects of the station (McKim, Mead & White) is being erected by the government on a site west of the station on Eighth Avenue and extending from 31st to 33rd Street and about half way from Eighth to Ninth Avenue. Both buildings overarch the cut that extends between the tunnel openings, and the handling of arriving and departing mail on the tunnel trackage, far below the street level, has required the installation of an ingenious and elaborate mechanical system.

A private street runs along the west side of the Post Office building, giving entrance from 31st and 33rd Streets to the partly completed westerly portion of the building. This temporary structure, which is now in use in connection with the new railroad station, is designed with an inner covered driveway 300 feet long and 32 feet wide and a mailing floor two feet above the street level, 312 feet long and 35 feet wide, for

loading and unloading mail wagons. The arrangements comprise a large trucking plaza, and offices for a considerable force of postal employees. Between the mailing floor and the platforms on the track level is a basement level, with ample space for a complete railway mail post-office equipment; and at the track level are four platforms and six tracks set apart for the mail service, making provision for twenty-six mail cars at a time.

Outgoing mail may be delivered to trains on the underground trackage, and incoming mail received *via* a 12-foot wide motor-truck subway running for a distance of nearly 1,000 feet east and west along the track, with transverse branches. Mail arriving at the Post Office in wagons is sent down to the basement and track levels and to the subway by spiral chutes or by plunger elevators. A large number of motor trucks, of 4,000 pounds capacity, has been provided, and the elevators are of sufficient size and capacity to raise and lower the loaded trucks between the different levels.

These facilities, however, although ample for the allotted traffic of a good sized modern railroad station, are not adequate to handle the enormous quantities of mail which arrive at and depart from this vast terminal. Over forty per cent of the entire weight of mail entering and leaving New York city is carried over the lines of the Pennsylvania Railroad, between 250 and 300 tons of mail being handled daily, comprised in 12,000 to 16,000 pouches weighing from a few pounds to 300 pounds apiece. This concentrated mass of mail must be handled with extraordinary dispatch in connection with trains moving quickly in and out of a trackage network situated fifty feet under ground. The problem was presented of devising a mechanism which must be not only thoroughly reliable and of ample capacity for the work, and so designed as to fit into an underground space cramped in the nature of things by the building structure itself, but must also be free from all possibility of causing delay to train movements or interfering with lines of sight on signals. In other words, the task was to install a complex machine for executing one of the primary functions of a railroad station—mail handling—in waste underground space that had already been reduced to the lowest practicable amount by the unalterable plans of the architects of this unique building. This problem, in which the Post Office Department was so vitally interested, was intrusted to a mechanical engineer who had already demonstrated special ability and resourcefulness in government work in the Treasury Department, Mr. Woodwell, of the firm of L. B. Marks & J. E. Woodwell, consulting engineers, New York city. His solution, a most remarkable one in departing almost entirely from conventional methods, by reason of the inflexible restriction above referred to, has proved a success in the uninterrupted facility with which the mails have been handled from the start. The electric-motor operated apparatus for handling the outgoing mail was put into motion coincidentally with the opening of the new railroad station, and worked without a hitch, thus demonstrating on the first test the capacity, speed and smooth working of the machinery. To the writer the achievement seemed so clearly an expression of an individuality—that of an engineer of the modern type—that information in regard to the work was sought in a personal interview with Mr. Woodwell, and the unique methods and devices employed were made clear by the following explanation of the system as a whole divided into two distinct parts for handling outgoing and incoming mail respectively. The theater of action is in the lower part of the Post Office building and is set on three main stages, viz., at the surface and at two different underground levels. These are the street level, with the mailing floor about two feet above it; the basement fitted up as a Post Office, and duplicating the interior equipment of a group of standard R. P. O. cars, and the track level, on which the mail cars stand on their six tracks adjacent to the four separate platforms.

The outgoing mail, constituting 80 per cent of the total tonnage, is handled by an elaborate equipment for vertical and horizontal transportation of the pouches. Spiral gravity chutes are provided to serve each of the track platforms. The chutes terminating at the two "island platforms" (Nos. 13 and 14) are double spirals, commencing at the basement and extending downward to the level of a system of electric motor operated belt conveyers installed at a point midway between the basement and the platform. At this point each chute discharges upon either of two conveyer belts, one of which runs eastward and the other westward. A "tripper" and spout, running on a third rail, serves to discharge the pouches from each belt into the waiting cars standing on either side of either platform. To make this clear, consider the delivery of mail to a train standing on track 22, platform 13. At the chute entrance in the basement the pouches, dumped into the chute compartment leading to the west belt, are carried along on the latter until they reach the tripper mechanism, consisting of a set of idler pulleys through which the conveyer belt runs and which may be placed at any point on the travel of the belt by the car man handling the loading. The tripper is mounted on a carriage made self-propelling by an electric motor with gearing, clutches, and control levers and pedals, so that it may readily be brought to a point opposite the door of the mail car. One of the idlers is so arranged above the plane of the traveling belt that a pouch traveling along on the belt on reaching the idler is caused to ride up over the idler and on to a deflecting guide and so into a delivery spout attached to the tripper. The only manual operation therefore is the setting of the motor-propelled tripper and the inserting of its spout into the door of the car; when this is done the stream of pouches pours in at the door of the car, there to be stowed away by the car man. Two of the platforms are curved, which necessitated the installation of two conveyer belts in series for each of these platforms, with a special device for transferring the pouches from one belt to the other.

By using both compartments of this double chute, delivering to the east and west belts at once, four cars can be loaded simultaneously on the two tracks bounding this platform (No. 13). The trippers are shifted along from car to car upon signals between the chute entrance on the upper level and the car man. Should the conveyers be out of service, the pouches emerging from the chute compartments can be delivered direct to the platform and handled from that point by hand trucks.

There are four systems of these spiral chutes in all. The north chute has three entrance openings on the mailing floor, one leading to the basement and the other two having openings in the basement also and going to the track level, where they deliver on the east and west conveyer belts installed over platform 8. The south chute is a quadruple one leading to platform 4 and having the same layout as the north chute just referred to, but having in addition a compartment leading from the mailing floor direct to the trucking subway. In the design of the spiral chutes, on account of the restrictions of head room and structural conditions, it was necessary to make numerous offsets of straight and curved slides and to employ changes in pitch of the spiral, baffle plates, and reverse curves; the solution of the problem being rendered more difficult by the wide variation of the load, ranging from the small, nearly empty canvas pouch to a 300-pound bag filled with periodicals. Experiment has shown that the time of arrival of a single letter and of a 300-pound pouch at the bottom of the chutes is approximately the same.

The several direct chutes installed in addition to the spiral chutes are of parabolic form, securing the maximum speed of descent of the pouches, yet delivering the latter with the minimum of velocity at arrival.

For the conveyer belts, about half a mile of the best rubber belting—five-ply canvas of long-fiber cotton impregnated and covered with rubber on both sides—is used. The use of ball-bearing rollers to support the belts minimizes wear, and eliminates all "field repairs" by enabling all wearing parts to be replaced without delay by duplicate interchangeable parts.

Four plunger elevators, operating between the different levels, can be used for lowering outgoing mail in emergencies, but their regular use is for lowering pouches of registered mail and for lifting incoming pouches.

For handling the incoming mail, one of the track platforms (No. 4) has an underground conveyer—two belts leading from east and west—delivering to a bucket elevator installed at an intermediate point. "Loading stations" spaced short distances apart are provided, having trap-door openings in the floor, through which the pouches are thrown from arriving mail cars to be received on a moving belt. The design of this co-ordinated conveyer and elevator equipment was one of the difficult special problems of this handling system. The buckets of the elevator pick up the pouches as they come to it from the belt, and it is necessary to eliminate all possibility of crushing or injuring a pouch, or deranging the apparatus, at the transfer point between belt and elevator. To insure this safe handling each pouch must be transferred from the belt to the elevator at the right instant for one of the buckets to receive it. This object has been accomplished, first, by operating the whole conveyer and elevator system from a common electric motor installed at the top of the elevator shaft, and second, by applying a time-interval operation to the receiving of the pouches on the belt itself. When a pouch is thrown into the opening of a loading station it lands, not on the belt directly, but on a shelf above the belt. From this intermediate receptacle the pouch is automatically pushed at the right moment on to the belt running beneath. The time of this deposit on the carrier is controlled by the movement of the distant bucket elevator, through the medium of compressed air in piping connecting with a differential piston mechanism which moves the pusher back and forth; the buckets as they approach the delivery point of the belt, by operating a compressed air valve included in this piping, cause the pusher to operate at just the right moment. An interlocking mechanism incorporated with the loading levers of the stations prevents conflict of delivery of pouches from the two parts of the belt. When one belt is working the other is out of operation. The bucket elevator can handle 1,200 bags an hour.

In the annexed pictorial view almost the full activity of the different mechanisms may be traced. The private street at the ground level and the common motor for the bucket elevator and underground conveyer appear at the top of the view. Outgoing pouches are being dumped in the spiral chute leading from the Post Office in the basement to platform 13, and are being loaded in a car on track 22 standing at this platform. The other overhead conveyer over platform 14 is also well shown. In the middle of the view is a motor truck standing on platform 14, which is at the door of one of the plunger elevators. At the extreme right is the south spiral chute in operation, and behind the same, incoming mail is being received on the basement level, delivered by the bucket elevator from the belt running under platform 4. The train which brought this mail is standing on track 8 in the background, and underneath may be seen the 22-foot high motor truck subway.

Freak Shadows in Oil

By J. Mayne Baltimore

IN the crude oil producing regions in California there are scores of large ponds of this material. After being pumped to the surface, the petroleum is emptied into depressions in the earth, where it remains for a time. Later the crude oil is placed in barrels, large metal cans, or else in big reservoirs. These oil ponds are known as "sump holes."

There is one very peculiar thing about these "sump holes," and that is in the way of producing what are known as "freak shadows." These are real shadows, but, notwithstanding this fact, they are decidedly "freaky." If the sun is brightly shining and a person stands for a few moments on the margin of the "sump hole," so that his shadow falls on the surface of the petroleum, and he then quickly changes his position, the dim shadow remains just where it was originally cast. In other words, the "shadow does not follow the substance."

This may seem like a paradox, but it is true. The instant a person shifts his position his shadow is again cast in a new place, yet the former shadow remains unchanged. The longer a person stands in one particular spot, the longer will the former shadow be visible.

Hundreds of experiments have been made along these lines, and every time the same results have been produced. The simple explanation for this phenomenon is that under the hot sun gas is being constantly generated down in the body of the petroleum, and it rises to the surface in the form of little, minute bubbles. So very small are these bubbles that they are scarcely visible to the naked eye. Millions of these wee-bubbles are rising to the top all of the time, when the bubbles break and the gas is liberated, passing into the air.

Both the gas and bubbles are so very super-sensitive to the temperature that even one's shadow cast for a moment across them is affected. The temperature is lowered. Whenever the substance quickly changes position the shadow remains until the rays again warm up that spot and the shadowy outline slowly fades away. Of course the "freak shadow" may be seen for only a very few seconds.

A $15,000 Prize for Aeroplanes

MR. EDWIN GOULD has offered, through the columns of the SCIENTIFIC AMERICAN, the sum of $15,000, which is to be awarded for the construction of a heavier-than-air flying machine, equipped with more than one motor and propeller.

The conditions governing Mr. Gould's offer were published in the SCIENTIFIC AMERICAN, issue of November 19th, 1910.

Our Weekly List of Patents

THOSE readers of the SCIENTIFIC AMERICAN who may miss the List of Patents granted in the United States, which it has been our custom to publish from week to week in the advertising pages, are referred to the SCIENTIFIC AMERICAN SUPPLEMENT for the record.

Science in the Current Periodicals

In this Department the Reader will find Brief Abstracts of Interesting Articles Appearing in Contemporary Periodicals at Home and Abroad

The Harvest Moon

"NEAR the time of the autumnal equinox, the moon, at her 'full,' rises shortly after sunset for several evenings in succession, which circumstance gives rise to a series of brilliant moonlight nights, and the moon being above the horizon until late in the morning, presents a charming appearance besides prolonging the light which is so beneficial to the husbandman at this season of the year. The full moon that occurs nearest to September 22nd has long been known as the 'Harvest Moon' on account of the peculiar advantages derived from moonlight during the time of harvest in England, and its yearly return is always celebrated as a festival among the peasantry. The circumstance of this moon rising for several nights in succession at nearly the same hour, immediately after sunset, which has given it an importance in the estimation of farmers, is not generally understood by the public, but the true cause has long been known to astronomers and can be very easily explained." An exposition of the astronomical conditions which give rise to the phenomenon is given by A. K. Bartlett in *Popular Astronomy*, from which we are quoting. "It arises from the fact that the ecliptic, or the sun's apparent path through the heavens, is variously inclined to the horizon at different seasons of the year. The celestial equator is always at the same angle with horizon, and hence equal portions come above the horizon in equal periods of time. If the moon moved in the celestial equator, she would rise and set directly in the east and west points of the horizon respectively, and she would rise later each night by a nearly constant interval. But the moon moves in a path which is constantly inclined to the ecliptic at an angle of about 5 deg., though for the present explanation she may be regarded as moving in the ecliptic; and as the ecliptic is inclined to the celestial equator at an angle of 23½ deg., the moon, in all parts of her orbit, does not rise at equal intervals on each succeeding night.

"When the constellation Pisces is in the eastern horizon the ecliptic rises with the least angle. Now, in September, at the autumnal equinox, the sun being in the constellation Virgo, the moon at her "full," when opposite to the sun, is in Pisces and rises at sunset. On the following night, though the moon has advanced in her orbit about 13 deg., yet her path being very oblique to the horizon, she will be but little below her position at the same time on the preceding night. She rises, therefore, only a little later, and for several evenings appears in the east at nearly the same hour after sunset.

"Though the differences in the time of the moon's rising are always great when she is in or near the constellation Virgo, and small when she is in or near Pisces—that is, every month—yet we never notice these variations except in autumn. In fact, we seldom observe the moon's rising at all unless it be when she rises near sunset, or in the very early evening. We usually give more attention to the full moon, and the moon can be full in or near Pisces, where the difference in the time of her rising is least, only when the Sun is in or near Virgo, which cannot occur except in September at the time of the autumnal equinox. In March the conditions are reversed, and the moon at her "full," rises on successive evenings later than at any other time of the year.

"In our latitude, the difference between the hours at which the full moon rises on succeeding evenings in September, amounts, on the average, to rather more than twenty minutes, or about half an hour less than the mean interval, while in March the average difference is about 1 hour and 20 minutes, the least possible variation in the time of her rising being 10 minutes, and the greatest 1 hour and 30 minutes. Those parts of the ecliptic which rise with the smallest angle set with the greatest, and those which rise with the greatest set with the least, so that, while in September the full moon rises at nearly the same hour on successive evenings, the time of setting varies considerably, owing to the large angle of the ecliptic with the western horizon. The phenomenon of the "harvest moon" is much more striking in Northern Europe and in Canada than in the United States; and in very high latitudes the moon, when it has its greatest possible declination, becomes circumpolar for a certain time each month, and remains visible without setting at all (like the "midnight Sun") for a greater or less number of days, according to the latitude of the observer.

"The husbandmen of old believed that the so-called 'harvest moon' was a divine interposition to prolong the day and thus aid them, but science has shown that the phenomenon is simply the result of natural law. The name so devoutly given is, however, still lovingly cherished, and as long as the solar system preserves its present relations, the return of the "harvest moon" will each year commemorate the simple faith of the first observers of this crowning beauty of our September nights."

Modern Development in X-Ray Technique

IT is extremely doubtful if any purely scientific discovery was ever more quickly followed by a world-wide and lasting interest, or put to practical use, than Roentgen's discovery of X-rays. An interesting historical review, leading right up to the present state of radiography is given in *Knowledge* by Reginald Morton, M.D. We quote here some of the essential points of Dr. Morton's article.

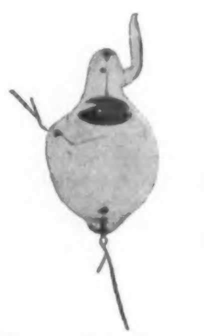


Fig. 1.—The original Crookes tube.

Fig. 3.—A modern X-ray tube.

"The way was paved for Roentgen's work by the experiments of Crookes with highly exhausted vacuum tubes. He observed that with increasing vacuum there was formed a dark space around the kathode, which increased in extent as the vacuum was increased. Concurrently the glowing gas which at first entirely filled the tube gradually disappeared. He also found at this stage new radiations were given off from the kathode, their direction being at right angles to the surface of emission. These he called 'kathode rays,' and he ascertained from their behavior to a magnet that they carried a negative charge. Owing to their curious properties he was under the impression that he had discovered a fourth state of matter —'matter in radiation'—but he altered this view later on when he found that the observed phenomena were capable of a different explanation. By means of a concave kathode he was able to bring these rays to a focus, and by directing them on to some substances, such as fluor spar, calcined shells, and various others, he produced brilliant fluorescence and high temperatures if the action were prolonged. He further observed that when the exhaustion was carried to such an extent that the dark space reached out to the inner surface of the tube itself, the latter showed a beautiful green fluorescence, as well as the rise in temperature, and that these effects were intensified if the kathode was of concave form and the wall of the tube at or near the focal point of the latter.

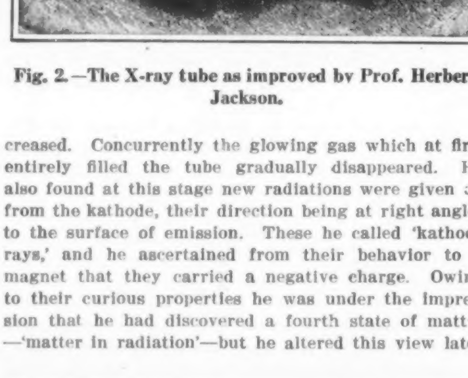
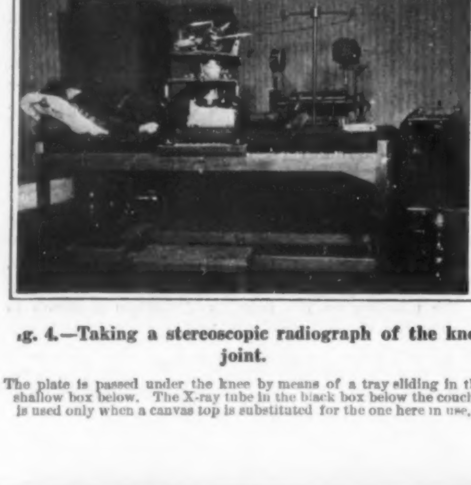


Fig. 2.—The X-ray tube as improved by Prof. Herbert Jackson.



ig. 4.—Taking a stereoscopic radiograph of the knee joint.

The plate is passed under the knee by means of a tray sliding in the shallow box below. The X-ray tube in the black box below the couch is used only when a canvas top is substituted for the one here in use.

"There is not the least doubt that the X-rays were produced in these experiments, and the question may well be asked how it came that they were not observed by Crookes. The answer is very simple. Being invisible to our eyes they would easily escape observation in the ordinary way; then we must remember that Crookes confined his studies to what was going on inside the tube, and at that time there was no evidence of any kind to suggest even the possibility of radiations passing through the wall of the tube.

"The publication of his famous paper soon started many other men experimenting in the same direction, and in 1892 Hertz announced that the kathode rays would penetrate thin metallic sheets if placed inside the tube, and within their path. Soon after this Hertz unfortunately died, but his experiments were carried on by his assistant, Lenard, who in 1894 had a tube made with an aluminium window. This, when excited with an induction coil current, allowed the rays to pass outside the tube, and it was observed that they would also pass through other opaque bodies, such as paper, giving rise to fluorescence and phosphorescence in certain substances, and even affecting the sensitive salts of silver in a similar manner to ordinary light. The only mistake made by Lenard in these epoch-making experiments was in thinking that all these effects were due to the kathode rays alone.

"In November, 1895, Roentgen, while experimenting with a Crookes tube, noticed that a small screen coated with barium platinocyanide fluoresced brilliantly in the proximity, though the tube was covered with cardboard and no light could be seen issuing from it. Following up this phenomenon he made out that this radiation came from a spot on the Crookes tube corresponding to the point of impact of the stream of kathode rays. He further ascertained that all substances were transparent to this new form of radiation, though in varying degrees, depending on the atomic weight of the elements composing the substance. He also found that the radiation came in straight lines from the point of their origin, and that they could not be reflected or refracted, and were not in any way influenced by a magnet. It was now evident to him that he was in the presence of radiations hitherto unknown, and he forthwith set about an exhaustive study of their physical properties, so as to determine their exact nature, and so perfectly did he do this, that his original monograph has never been seriously added to up to the present time.

"Having shown how any inequalities in density in any given object would be registered on a photographic plate, he at once recognized the immense importance of the discovery to surgery, and made his communication to the Physico-Medical Society of Würzburg in December, 1895.

"To describe in detail the various steps in the development of all the apparatus used in radiology would, and does, fill many a good-sized volume. We may, however, trace the evolution of the more important parts of the modern X-ray outfit without going beyond the space usually allotted to such an article as this.

"In view of the fact that the whole science of radiology centers around the X-ray tube, and that everything else is subsidiary to it, we may very fitly consider this first. The original experiments were made with tubes of the well-known 'pear' shape originated by Crookes. In these the kathode stream was made to impinge upon some part of the wall of the tube. (X-rays are produced when a stream of kathode rays are suddenly arrested by impact against a solid body.) The area of impact was always large—sometimes the whole of the large end of the tube showed the characteristic green fluorescence, showing that the X-rays were being given off from its whole area. Under such conditions the images of a fluorescent screen or a photographic plate were much blurred and generally indistinct. This was, of course, a very great disadvantage, and had no other form

been available, it is safe to say that the science of radiology would have made very little progress. The first and the most important single contribution to the science was made by Prof. Herbert Jackson, of King's College, London. He made a tube with a concave kathode, and mounted at or near the focal point, a flat disk of platinum which also acted as the anode of the system. The result was that all the X-rays came from this point, and gave sharp shadows with clear outlines as well as details of minute structure. In all tubes working under normal conditions, the tendency is for the vacuum to slowly increase. The generally accepted explanation of this is that the electrons become imbedded in the walls of the tube, and so are put out of action. It is even believed that some are driven right through the glass. A certain number of those embedded can be restored to the body of the tube by heating the glass, and this was the only method of regenerating a tube in the earliest days of X-rays. The need for regeneration was owing to the fact that with the increase of vacuum the tube became so resistant that the electric current passed around the outside in preference to going through. Also the character of the radiation altered, so that a 'hard' tube, as it is called, gave very poor images on the photographic plate, although the screen appearances were fairly brilliant; the reason being that the rays from a hard tube are less active in affecting the sensitive salts of silver, and hence it does not necessarily follow that a tube that gives a satisfactory image of the screen will give a good account of itself when used for registering the image on a sensitive plate.

"Many devices have been brought out from time to time for regeneration of the vacuum in a convenient manner, and each has certain advantages. At the present time there seems to be an almost universal tendency among tube makers to employ some porous material such as asbestos, spun glass, leaves of mica, and so on. The material is inclosed in a small accessory bulb, the cavity of which communicates with that of the X-ray tube, and so arranged that when the resistance of the main tube rises beyond a certain degree the electric current passes through the small bulb, heating the porous material and causing it to give off some of its occluded gas. This passes into the large tube, lowers its resistance, and the current resumes its proper course.

"We must now turn to the improvements made during recent years in the coils and other high potential transformers. Before the days of the X-rays, induction coils were rated or compared with one another according to their spark length. The maker of a big coil aimed at a certain spark length, and was not very particular as to how it was obtained; but the curious fact was, that when one of these big coils was used for X-ray work the results obtained were not always those expected, though it was generally agreed that large coils gave better results than small ones. About the beginning of the present century many coils were in use giving sparks of twenty, thirty or more inches in length; but as it was realized that a spark length of anything up to six or eight inches was sufficient to overcome the resistance of any useful X-ray tube, it became apparent that nothing was to be gained by increasing the sparking distance of the coil beyond a certain point, which has been found to be about fifteen inches. The only other thing to do was to increase the quantity of current available, and so drive a larger volume of current through the X-ray tube. As is well known, the current from any induction coil is not continuous, nor even unidirectional. It is an alternating current, but the waves of one sign preponderate over those of the opposite sign. Owing to the fact that the resistance of an X-ray tube to an inverse current is less than to a current in the right direction, it is necessary that these lesser and inverse waves be kept as small as possible—the reverse current having a very deleterious effect on the life and performance of the tube.

"The first attempts at making these 'heavy discharge' coils, as they were called, were not very successful; in fact, until very recently, all these coils suffered from giving out too much inverse current, which, as we have seen, is very detrimental to the tubes.

"The newest coils are a very great advance on anything of the kind that has been brought out before. Not only are they very economical of primary current for the very heavy secondary discharge they give out, but they are for all practical purposes quite free from inverse impulses.

"The very latest type of induction coil for X-ray work is what is known as the 'single flash coil.' The construction of this is such that a radiograph of almost any part of the body can be made with a single interruption. There are different ways of bringing about this effect. One maker produces the interruption by means of the explosion of a small cartridge; another secures the same end by suddenly releasing a wire that is held down in a vessel of mercury with a catch and against a spring in compression. The act of turning on the current draws back the catch and the wire rushes up by the action of the spring, and the

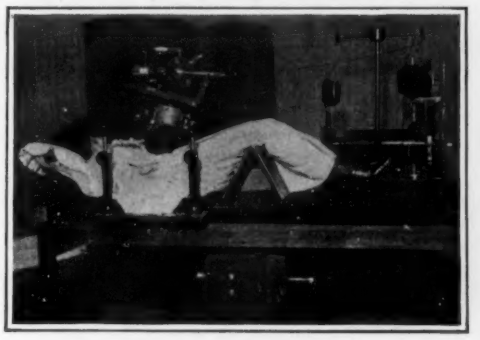


Fig. 5.—Radiography of the kidney.

The metal cylinder upon which the X-ray tube is mounted is pressed down into the abdomen reducing its thickness and preventing all movements of the kidney itself.

circuit is broken at the moment the wire leaves the mercury.

"This is the latest development of the induction coil, and in all probability it will have a far-reaching effect on the future of X-ray technique. It is not unlikely that in future we shall be regulating our exposures, not by so many seconds or minutes, but by the number of flashes or interruptions. What is now wanted is a means of giving any desired number at will, and, in all probability, this will be achieved before very long.

Fig. 6.—A radiograph showing a stone in the kidney.

Fig. 7.—Teleradiography.

The tube is placed two meters from the photographic plate against which the patient stands. The shadow of the heart is but very slightly larger than the heart itself and sufficiently correct for all practical purposes.

"Early in the days of radiology it was observed that the intervention of a diaphragm increased the definition and sharpness of the image, in the same way as in the photographic lens; then it was found that if instead of using a hole in a metallic disk the rays were made to pass through a metal tube a still further gain in sharpness was attained. So important is this, that the use of the tubular diaphragm is essential if the best radiographs are to be secured.

"One of the most difficult matters to deal with is that of movement. Some patients have the faculty of keeping still for comparatively long periods of time. Very many others have not; the movements may be voluntary, but are frequently involuntary from nervousness, or tremors that are not under control. All the organs in the thoracic, abdominal, and pelvic cavities move to a greater or lesser extent with the movements of respiration, and this is an important factor in assisting the performance of their normal functions. Some of these movements are easily restrained, others are not, and many devices have been brought forward for this purpose; but the most generally useful of all is that in which the tubular diaphragm is mounted in a framework that passes across the patient, and is so arranged that it can be lowered down and made to press firmly upon the part it is desired to examine. Movement can in most cases be perfectly restrained, and the improvement in the quality of the resulting image is, compared with that taken without any diaphragm, quite startling. One of its greatest uses is in the examination of the kidney for calculus. (See Fig. 5.) This organ under normal conditions moves about half-an-inch with each respiration, and if this is not restrained no clear image can be secured. With the compressor diaphragm this is easily done, the outline of the kidney is sharply defined, and its size, shape, and position are definitely registered. As might be imagined, the difficulty increases with the stoutness of the subject, but this is not nearly so important as it was, and a good result can be secured in nearly all cases, with a little care and trouble.

"The use of this device necessitates the X-ray tube being above the patient, and it is not easy to make a preliminary inspection with the fluorescent screen which, in many instances, is all that is required. Where many have to be examined, as in the outpatient department of a hospital, it is a great convenience to have a couch with a canvas top upon which the patient is laid. The X-ray tube is fixed in a ray-proof box with an opening at the top through which the rays emerge, and this box can be moved in both directions so as to bring it under any desired part. The canvas being transparent to the rays, we can, with the aid of the screen, look through the patient and frequently see all that is wrong; if there is any doubt, an X-ray plate is laid on the place and steadied with sandbags while the exposure is made. This is a convenient method for dealing with a number of cases, and the results are good enough for ordinary conditions."

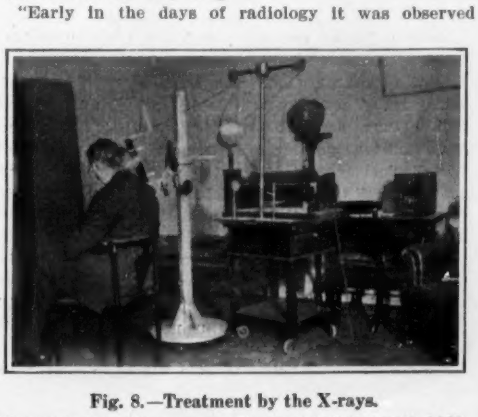


Fig. 8.—Treatment by the X-rays.

The dose is measured by means of a "pastile" held in the tube shield.

What the Panama Canal Will Mean in Our Relations with Peru

IN commenting upon impressions recorded by Mr. John M. Turner, a flour and grain expert, the editor of *Peru To-Day* remarks:

"A great development is in prospect for the West Coast of South America. . . . The effects of this will be felt in advance of the completion of the Panama Canal in 1914. While the whole of South America will benefit from this most wonderful of modern undertakings, there is no question in the minds of thinking men that Peru is in a position to realize to the utmost the advantage to be derived from the opening of this great waterway. It is with this in view that the business departments of our great northern neighbor are so active. Let there be no mistake about it. The United States of North America may have been slow in waking up to the existence of this market so long neglected, but the awakening has come with the noise of the dredges and the drills working in the 'big ditch,' and the trade map of this continent is about to undergo a radical modification. The Pan-American Railway may be a dream, but the Panama Canal is a reality, and American shipping will follow the commercial representatives, tourists and investors of that country who are our frequent guests. American capital has already developed important industries and built great railways in Peru, and is even now seeking, and finding, new work to do. The United States Department of Commerce and Labor knows that there are metals, fabrics, and natural products of many kinds in Peru for which they can provide a market, and that in return we need many things which can best be supplied from their factories. On the other hand, the Peruvian government, through its consuls and Department of Fomento, is actively studying commercial and manufacturing conditions in North America, and is ready to consider and act upon every suggestion which has merit behind it."

A Shadow in Court

By William F. Rigge, S.J., F.R.A.S.

WHILE we take it as a matter of course that almost any of the sciences may be called upon to bear testimony in a criminal court, we might be somewhat surprised to hear of an astronomer being summoned to testify to the time a certain photograph was taken from the position of a shadow. This actually happened on December 9th, 1910, in Omaha.

F. E. was arraigned for having with malicious intent placed a suit case containing dynamite on the porch of T. D., between the hours of 2 and 3 in the afternoon of Sunday, May 22nd, 1910. The evidence against the accused was altogether circumstantial except in one instance, in which a girl 16 years of age testified that she had seen E. carrying the suit case shortly before 3 o'clock. Upon investigation, John O. Yeiser, the attorney for the defendant, found that the witness, before walking to the D. residence, had attended service at a church a mile away. The minister said that the services had concluded about 3 o'clock, and that the young people had lingered a while about the church and had had their photographs taken several times before dispersing.

In looking at one of the pictures in which the witness figured, the attorney was struck by the rather prominent position of a shadow in it. It then occurred to him that he had somewhere read an article in which the date and exact time of a photograph had been found from a shadow. The thought flashed upon him, "What if the time of this photograph could be proved to be after 3 o'clock, and the testimony of the only eye-witness invalidated!"

Consultation with his friends brought the attorney to the writer, who soon furnished the desired proof and afterward testified that the photograph in question had been taken within one minute of 21½ minutes after 3 o'clock. As this threw out the testimony of the only eye-witness, the evidence was purely circumstantial, and resulted in splitting the jury six to six.

After this introduction the reader will most likely be interested to know the method by means of which a shadow in a photograph may be made to betray the exact time of its taking.

The principle was fully explained in the SCIENTIFIC AMERICAN of September 24th, 1904. It is briefly this, that in measuring the distance that a shadow is cast down, north or south, and east or west, we can find the sun's place in the sky at the moment, and thence deduce the time of the day and the day of the year. For this purpose we make use of the astronomical triangle whose vertices are the zenith, the pole, and the sun. The side extending from the zenith to the pole is the complement of the latitude of the place. The side from the pole to the sun is the complement of the sun's declination. The third side, from the sun to the zenith, is the sun's zenith distance, the complement of its altitude. The angle at the zenith is the sun's azimuth counted from the north. The angle at the pole is the sun's hour angle, the local apparent solar time. The angle at the sun is called the parallactic angle.

Of these six parts, three sides and three angles, three must be given in order to enable us to compute the rest. In the present instance, the sun's azimuth was known from the ratio of the distances that the shadow was cast eastward and northward. The sun's altitude also was known from the ratio of the vertical and horizontal distances. The latitude and longitude were obtained from the city map with reference to our observatory. And finally the sun's declination was known, because the day was given and the hour was about 3 P. M.

There were thus four out of the six parts of the triangle given, one part more than was needed. As the angles at the pole and at the sun were the only unknowns, each of the four known parts was in turn taken as the third unknown. This furnished four methods of solving the problem, in which, along with the time and the parallactic angle, the sun's altitude, azimuth, and declination, and the latitude of the place were successively taken as unknowns. The results were:

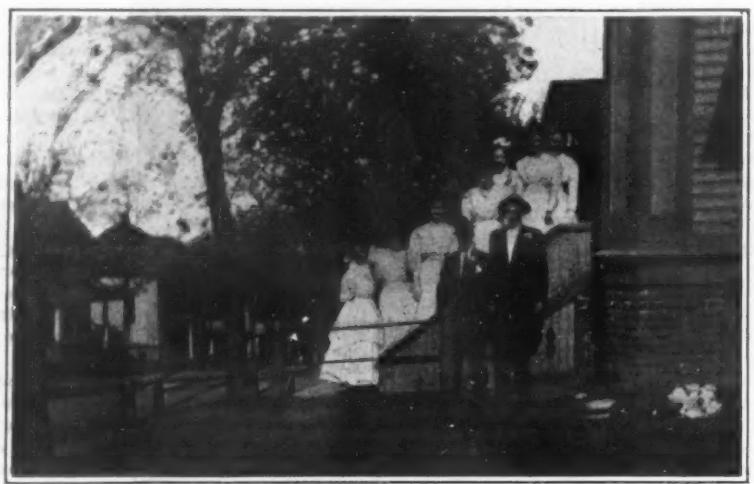
3 o'clock 21 minutes 12 seconds.
3 o'clock 21 minutes 31 seconds.
3 o'clock 21 minutes 29 seconds.
3 o'clock 21 minutes 33 seconds.

The mean of which was 3 o'clock 21 minutes 26 seconds, and the residuals, or differences from the mean, 14, 5, 3, 7 seconds, the extremes being 21 seconds apart.

The close agreement, of the four methods showed that no appreciable error had been made in any of them. In the first method the azimuth of the sun had been obtained by assuming the curb line of the street to be correctly in the meridian. The second method made no use of the azimuth at all. The third method used no other data than the latitude and longitude of the place and the measures made upon the building, and found from them the time of the day as well as the day of the year. The error in the computed declination of the sun was about one-fourth of its daily variation at the time, so that there could be no doubt whatever of the day. The date, as far as the shadow was concerned, might also have been July 22nd as well as May 22nd, because on both of these days the sun's declination is the same. But besides being altogether out of the question, the later date was negatived by the immature condition of the foliage shown in the photograph.

In the fourth method the latitude, which had been taken as unknown, differed only 4 2/3 miles from the truth. If the time had been given, the longitude would have been found within about the same range.

The data used in the problem were that the shadow had fallen 14.22 feet down, 13.10 feet eastward, and 3.43 feet northward. The horizontal distance was found to be 13.52 by measurement and 13.54 by computation. An error of one-tenth of a foot in the shortest horizontal side would have changed the time 1 minute 54 seconds. The same error in the altitude would have caused a difference of 1 minute 15 seconds. The omission of the correction for refraction would have produced a difference of 2 or 3 seconds.



A shadow in this picture proved an alibi.

The shadow is seen very prominently to the right and its exact location on the building was an easy matter. The identification of the object that cast the shadow was not less easy. The distance of the shadow from the object was 19.62 feet. In one minute the shadow moved at the time 0.080 foot upward, 0.053 foot to the right, and 0.096 foot in its apparent path. It ran the width of a weatherboard, 0.37 foot, in 4 minutes 37 seconds.

The latitude was 41 deg. 6m. 42s. N. and the longitude 6h. 23m. 48s. W. The sun was 3 minutes 33 seconds fast, and the time used central time.

In some respects the present problem was much more interesting than the one described on September 24th, 1904, in this journal, by reason of the various solutions it presented and its very practical application.

The "Arkansas," Our Latest Battleship

WITH the launching of the "Arkansas" from the yard of the New York Shipbuilding Company, Camden, N. J., on January 14th, there was floated the latest and most powerful battleship of the United States navy. With a displacement at normal draft of 26,000 tons, she greatly exceeds the next largest ships of our fleet, which are the "Florida," now completing in the New York navy yard, and the "Utah," which was built at the same Camden yard. These two vessels displace at normal draft 21,850 tons, so that the "Arkansas" is over four thousand tons greater, a difference which about equals the displacement of some of the larger cruisers, such as the "Baltimore" and "Chicago," which twenty-five years ago formed the first addition to our new steel navy.

The "Arkansas" and the "Wyoming," which is being built by William Cramp & Sons of Philadelphia, contain certain distinctive characteristics which entitle them to be considered as a national type. Chief among these is the great power of the battery and its location in two-gun turrets placed, all of them, on the central longitudinal axis of the ship. This plan originated with our Construction Corps, and was first embodied in the "South Carolina" and "Michigan." Another special feature of this system of mounting is the placing of the gun turrets in pairs adjacent to each other, while the guns in one turret are carried at a sufficient height to fire across the roof of the adjacent turret, without interfering with the sighting or manipulation of the latter.

At the time of its introduction, this plan was subjected to a large amount of criticism by foreign naval constructors and sea-going officers, on the ground that the blast from the upper pair of guns must necessarily interfere with the operation of the lower pair. In order to settle this question, our naval Bureau of Ordnance carried out full-sized tests with 12-inch guns mounted temporarily in the proposed positions; and the results proved that the system was perfectly feasible.

The grouping of the turrets in pairs, coupled with their location on the longitudinal axis, secures the valuable advantages that the whole battery may be concentrated over a broadside arc of fire on each beam of 95 degrees, and that four 12-inch guns can be fired dead ahead and dead astern, and through a complete arc of 270 degrees. This system of centerline mounting was adopted at a time when the foreign navies were mounting four of the guns of the main battery in two turrets, placed one on each side of the central superstructure—an arrangement which, in broadside engagements, necessarily shut out two guns from service. It was considered at that time that the ability of these four guns to fire ahead and astern more than compensated for the above-named loss of broadside fire. Gradually, however, these foreign navies have swung around to the American point of view; and it now looks as though the centerline mounting will become universal in the large ships and armored cruisers of the future.

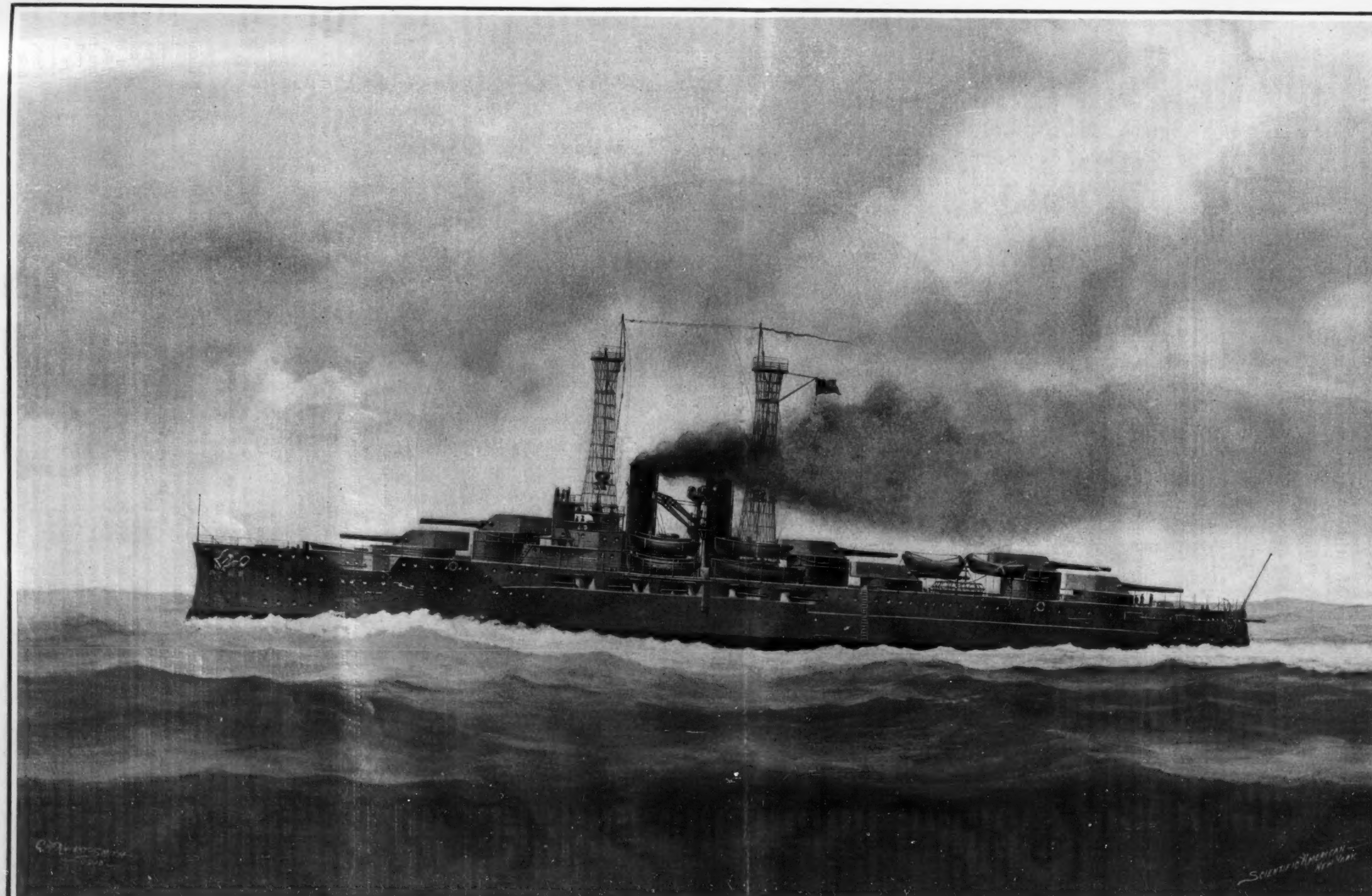
The "Arkansas" carries twelve guns of the latest 50-caliber pattern. This fine weapon fires an 867-pound projectile with a service velocity of about 3,000 feet per second, and a muzzle energy of over 53,000 foot-tons. At the modern fighting range of 9,000 yards, it can penetrate the heaviest armor afloat. The gun has been proved to possess remarkable accuracy; and, with the modern system of fire control from platforms at the top of the new lattice-work masts, our gunners, even at the extreme ranges, when once they have found the mark, will be able to hold the gun upon the enemy and place well over fifty per cent of the projectiles upon the ship.

The main belt, 11 inches thick at the top, tapering to 9 inches at the bottom, covers all turrets and magazines for a length of over 400 feet and reaches 6 feet below the normal water line. It tapers to a thickness of 5 inches at the ends. Above this belt is another, 11 inches thick at the bottom, 9 inches at the top, extending for the full length, 400 feet, of the main belt. There are two protective decks above the magazines, and elsewhere one protective deck. The turrets carry 12 inches of armor on the front, 11 inches at the back, and 9 inches on the sides, the roof protection being about 4 inches. The barbettes, below all turrets, are protected by 11 inches of armor. Furthermore, in way of the magazines, the "Arkansas" will be protected below the water line by longitudinal bulkheads 1½ inches thick.

The "Arkansas" is to be driven by turbine engines at 20½ knots speed. The coal bunkers can stow 2,500 tons of coal, and there will be 400 tons of oil in the double bottom. At a 10-knot speed, the radius of action will be 8,000 miles. The total cost of the "Arkansas," when completed, will be slightly over ten million dollars.

If our readers compare the "Arkansas" with the "Florida" they will note that there is no break in the line of the upper deck. The "Arkansas" presents a gradually rising freeboard at normal draft, from about 18 feet at the stern to 25 feet at the stem, an arrangement which we think greatly adds to the appearance.

An excellent feature is the fine command (height of guns above water line) of the main battery. Even when the ships are loaded to their full displacement, the freeboard of the forecastle deck will be 23 feet 2 inches, amidships 19 feet 2 inches, and aft 16 feet 3 inches. The height of the guns above water in the six turrets at full load will be respectively, 28 feet 3 inches, 36 feet 3 inches, 32 feet 11 inches, 24 feet 11 inches, 31 feet 3 inches, and 23 feet 3 inches. With such good command it will be possible to fire the lowest guns in any weather in which an engagement may occur.



Length, 562 feet. **Beam,** 93 feet 2½ inches. **Normal draft,** 28 feet 6 inches. **Displacement,** 26,000 tons. **Contract speed,** 20.5 knots. **Coal,** 2,500 tons. **Armor:** Belt, 11 inches; casemate, 6½ inches; turrets, 12 inches; barbettes, 11 inches. **Armament:** Twelve 12-inch; twenty-one 5-inch **Torpedo tubes,** two 21-inch. **Officers and men,** 1,060.

The 26,000-ton "Arkansas," launched January, 1911; to be completed May, 1912.

The Heavens in February

Our Monthly Astronomical Page

By Henry Norris Russell, Ph.D.

ONLY last month we were discussing one of those interesting stellar systems in which the mutual eclipses of two stars afford us information which we could get in no other way about their real dimensions. In the intervening time a new and very interesting case of the same sort has been described, which deserves some notice here. The star is known as u Herculis—being denoted by a Roman rather than a Greek letter because there are so many stars in this large constellation that the Greek alphabet is exhausted, so that the Roman has to be brought in and pretty well used up before all the naked-eye stars are lettered. It has long been known that the star varies in brightness, but the true character of its variations has only been detected very recently, by co-operation between the Allegheny Observatory, where its spectrum was investigated by Dr. Baker, and the Harvard Observatory, where its light was measured by Prof. Wendell.

The spectroscopic observations show that the star is a close double, with unequally bright components, revolving about one another in a nearly circular orbit, with a period of 2 days, 1 hour and 13 minutes. The measures of brightness show two unequal minima of about 13 hours duration separated by nearly equal intervals of approximately constant light, repeating themselves in the period already mentioned.

The deeper minimum, when 49 per cent of the star's light is obscured, comes at just the time when, according to the spectroscopic data, the fainter star should be in front of the brighter, and the smaller minimum, with a loss of only 2 per cent of light, corresponds to the eclipse of the fainter component by the brighter one.

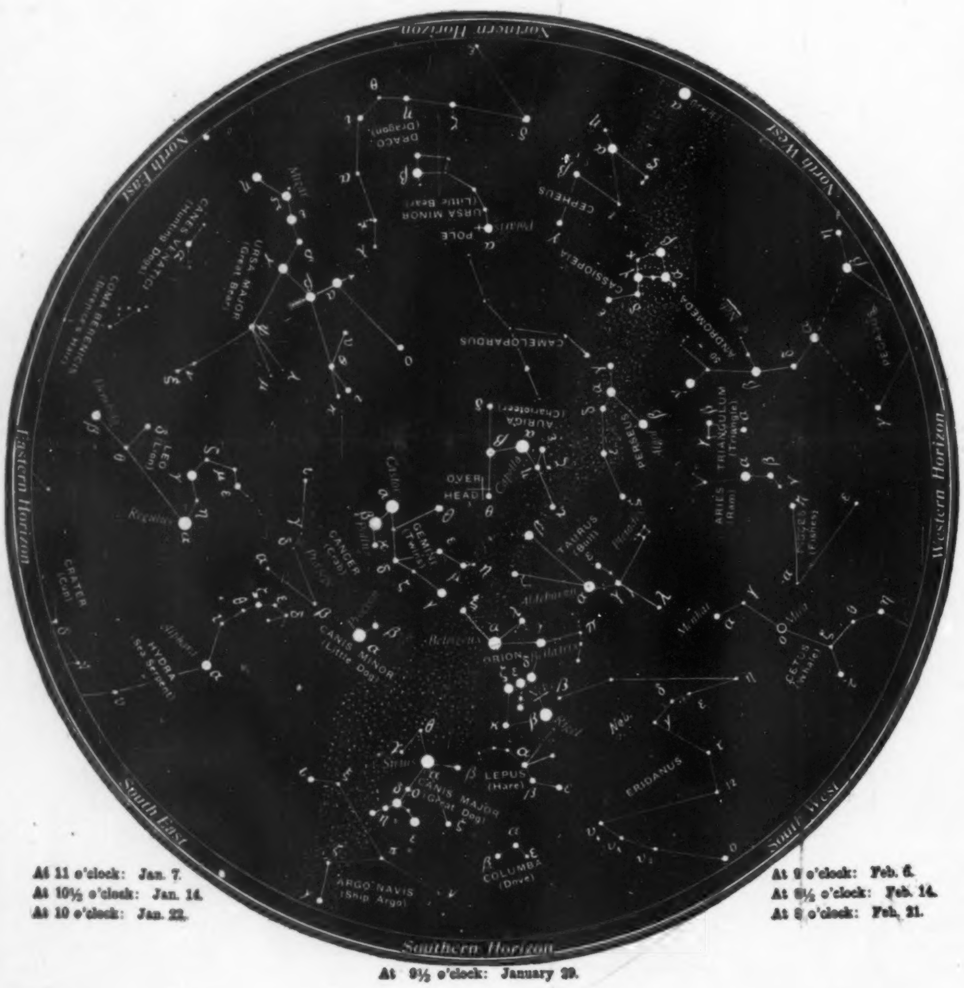
From these data Prof. Schlesinger of the Allegheny Observatory draws the following conclusions about the system:

The diameter of either star is 5,100,000 miles, or nearly six times that of our sun. The brighter star is 7½ times as massive, but only 1/27 as dense as the sun, while the fainter star, which is 2/5 as bright as the other, is of 2 9/10 times the sun's mass and of only 1/70 of its density. The brighter star gives off 2½ times as much light per square mile as the other does. The orbit of one about the other is inclined 15 degrees to a line drawn toward our sun. The distance of the centers of the two stars is 6,300,000 miles, and the nearest portions of the two are separated by 1,200,000 miles, or about one-quarter of the diameter of either. This distance varies from 900,000 to 1,500,000 miles, as the orbit is not quite circular. All these propositions are based upon a careful study of definite and reliable evidence, and there is at present no other star about whose nature we know so much.

It may be added that the star is very white—of the so-called Orion type—which is for good reasons supposed to be evidence of very high temperature, and that its distance from our system is in all probability very great. Prof. Schlesinger shows that, if the brighter star sends out as much light per square mile as our sun does, its distance from us must be about 200 light-years. If it is brighter per square mile than our sun—as seems to the writer extremely probable—its distance must be still greater, and it is not improbable that the light by which we now see this remarkable system left it fully five centuries ago.

Among the events of the month should be mentioned the discovery of another new star—this time in England, by Espin, on December 30th. At the time of discovery it was of the seventh magnitude. Photographs taken at Harvard show that it was invisible on November 17th, but of the fifth magnitude on November 23rd, so that it had faded considerably before discovery. It is in the constellation Lacerta, in R. A. 22h. 32m. 11.8s., and Dec. 52 deg. 15 min. 20 sec. north, right in the middle of the Milky Way, and shows the characteristic spectrum of paired bright and dark lines.

In fact, it is in every way a typical nova, and its appearance, like that of its predecessors, is probably due to collision between some star, far in the depths of space, and a nebula or cluster of meteoric bodies.



At 11 o'clock: Jan. 7.
At 10½ o'clock: Jan. 14.
At 10 o'clock: Jan. 22.

At 9½ o'clock: January 29.

At 9 o'clock: Feb. 6.
At 8½ o'clock: Feb. 14.
At 8 o'clock: Feb. 21.

Night Sky: January and February.

THE HEAVENS.

Turning from this faint newcomer to the unchanging constellations, our map shows that the finest region of the visible skies is in the south. Beginning right overhead with Auriga, we find Gemini on the left and Taurus on the right, just below; then the magnificent Orion and the Great Dog—whose other stars are brighter than one would think at first sight, so far does Sirius excel them. Still lower, on the very horizon, is Argo, whose brightest star, Canopus—next to Sirius in the whole heavens—can be seen due south and very low down from latitudes south of Virginia. On a level with Orion, and farther east, is the isolated bright star Procyon, marking the constellation of the Little Dog. Our initial shows how little relation there is between the imaginative and the real outlines of the group. Only two other stars besides Procyon are at all conspicuous. These bear the letters Beta and Gamma, and form with their far brighter neighbor a triangle of very unequal sides, much like the head of Aries.

Procyon is of considerable interest, both as one of our nearest neighbors in space, at a distance of ten light-years, and as a very remarkable binary, being attended by a very faint companion, visible only in the very greatest telescopes, which, though of about one-third the mass of its primary, gives only about 1/100,000 as much light. To the left of Procyon is Cancer, with the star cluster Praesepe, below which is the head of Hydra. In the east Leo is fully above the horizon, and in the northeast the Great Bear is well up. The Little Bear and the Dragon—hiding his head below the horizon—are due north. Cepheus and Cassiopeia are in the northwest, with Perseus higher up. The great square of Pegasus is setting, and Andromeda will soon follow. The southwestern sky, which contains Cetus, Eridanus, Pisces, and Aries, is very dull, and is enlivened only by the presence of Saturn in the last-named constellation.

THE PLANETS.

Mercury is a morning star all through the month, but is best visible at its beginning shortly after reaching his greatest elongation on the 2nd. He is then 25 degrees from the sun, and rises at 5:45 A. M., so that he can be easily seen before sunrise.

Venus is evening star in Aquarius and Pisces, and is rapidly becoming more conspicuous. She sets at about 6:30 P. M. on the 1st and 7:40 on the 28th.

Mars is morning star in Sagittarius, rising at 4:30 A. M. in the middle of the month. He is still a long way from the earth and relatively faint.

Jupiter is morning star in Libra. On the 3rd he is in quadrature west of the sun, rises about 1 A. M., and is due south at 6 A. M.

Saturn is evening star in Aries, setting about 10:45 P. M. on the 15th.

Uranus is morning star in Sagittarius, too near the sun to be easily seen. On the 10th he is in conjunction with Mercury, being five minutes south of the latter.

Neptune is in Gemini, and is well observable if one has a large enough telescope. His position on the 14th is R. A. 7h. 23m. 8s., Declination 21 deg. 26 min. north, and he is moving west and north at the rate of 5.6s. in R. A. and 12 sec. in declination per day.

The moon is in her first quarter at 10 A. M. on the 6th, full at 5 A. M. on the 13th, in her last quarter at 11 P. M. on the 20th, and new at 7 P. M. on the 28th. She is nearest the earth on the 9th, and remotest on the 21st.

In her circuit of the heavens she passes by Saturn on the 5th, Neptune on the 10th, Jupiter on the 28th. She is nearest the earth on the 9th, and Mercury on the 27th, none of the visible conjunctions being close.

A Remarkable Concrete Building

A SIX-STORY reinforced concrete building in Boston, for the use of a motor car company, has circular columns of the same diameter in the upper and lower stories and has a long span floor construction permitting a deep turntable well of large diameter in each story. The exterior faces of the walls are relieved by panels and moldings integral with the body of the wall. The front wall corresponds with the brick and stone face of an adjacent building and has a rather elaborate trimming of cornice, dentals, and carved stone, all of which, except the last, are cast integral with the body of the wall.

Correspondence

Our Smokeless Cannon Powder

To the Editor of the SCIENTIFIC AMERICAN:

In my article in the current number of the SCIENTIFIC AMERICAN, under the head, "Our Smokeless Cannon Powder the Best," an omission was made by the stenographer in copying the original draft of the manuscript, which was overlooked when sent in.

The first Maxim-Schupphaus smokeless powder consisted of:

9 per cent nitroglycerin.
½ per cent urea.
8 per cent soluble nitrocellulose.
82½ per cent tri-nitrocellulose.

The powder was made in two forms—one with and the other without nitroglycerin. The nitroglycerin compound gave the better results, and was therefore the favored composition. The formula for this nitroglycerin composition was omitted in my said article, only that without the nitroglycerin being given; hence this correction. HUDSON MAXIM.

New York, N. Y.

Utilization of Solar Energy

To the Editor of the SCIENTIFIC AMERICAN:

I have just read the article in the SCIENTIFIC AMERICAN of January 21st describing Fessenden's scheme of utilization of solar energy. It appears practicable; perhaps, but so cumbrous, with so much apparatus, and so much loss of energy in useless work, that its practical value is not very apparent.

We shall soon, as world time counts, cease to use the fossil energy of the sun. Some intermediate processes, wind and water power like Fessenden's, or the well-known conversion of the radiant energy into heat and this into work, may serve a pretty large purpose for a transition time.

But ultimately the world will use the direct radiation energy from the sun to operate immediately electromagnetic prime movers, with no cumbrous and very inefficient heat engines or wind plants.

This is the problem: To utilize for mechanical power the electromagnetic energy from the sun directly as electric energy, without transformation into heat or any other form of energy.

This problem I have presented to hundreds of young men in the engineering courses of the Pennsylvania State College; and some one of them may solve it. And I have tried a good many experiments, such as the meager facilities and time at my command would permit for its solution. Dr. S. P. Langley, the late secretary of the Smithsonian Institution, replying to something that I had written him about some of my work, said that he had done some work on this problem. I do not know whether any one else has tried or is now trying to solve this problem.

A tenth of one of the Carnegie research millions would lead to the solution of the problem. No other discovery in physical science would have such economic importance or so revolutionize life as the discovery of how to utilize the electromagnetic energy from the sun directly as electric energy for mechanical power. I. THORNTON OSMOND.

Fessenden on His Method of Utilizing Solar Radiation

To the Editor of the SCIENTIFIC AMERICAN:

In the sub-title of the article, January 21st, 1911, on my system for utilizing the energy of natural intermittent sources of power, the statement is made that "The difficulties in the way of its solution seem still to be very great. Whereas Fessenden assumes that water can be raised by the sun's rays to its boiling point, the highest temperature which is mentioned in scientific literature within our knowledge is 65 deg. C. or 149 deg. F."

It is unfortunate that the writer of the article did not write me before publishing his criticism, as I would have been able to refer him to more than a score of scientific publications in which water was raised above 100 deg. C. by the sun's rays, without the use of mirrors or other focusing devices; in fact, such experiments are so well known that I was not prepared to find the question raised at this state of our knowledge of the subject, or I would have given the references in my original article.

For example, in the first paper I take up, i. e., Prof. Very's article in the *Philosophical Magazine*, September, 1908, I find a record of two such experiments. One, on page 466, in which a temperature of 104 deg. C. is reached, made by Prof. Very, in regard to which he says (same page):

"The observation certainly shows that a solar radiation of 1.3 calories per minute per centimeter square is competent to produce a temperature above that of boiling water, and if the solar constant is as large as 3.1 calories, which I believe to be probable, the sun can give at the earth's distance a temperature of 195 deg. C."

Still further down he refers to an experiment of Langley's as follows:

"Langley obtained at his mountain camp on Mount Whitney, in a double hot-box of his own design, an *excess* of 98.5 deg. C. *above shade temperature.*"

It is unnecessary to give further instances, but I would add that I have boiled water in an ordinary Thermos jar in January by exposure to the sun's rays.

A second point to be noted is that all the above results were obtained with ordinary absorbing means, and that none of the experimenters employed the metallic reflecting-band substances used with my system. With these almost any temperature may be obtained, and I have melted solder in this way in a few minutes. In making this experiment the sun's rays were not, of course, focused at all, but fell perpendicularly, through screens transparent to solar radiation but not to the rays emitted from the oxidized surface of the solder. How hot it is possible to raise water in this way I do not know, as the steam pressure becomes too great after a few minutes for the glass to stand, so that I have never gone above about 100 pounds pressure per inch.

A third point to be noted is that the question of what temperature can be reached has absolutely nothing whatever to do with the practicability of my system. As every steam engineer knows, a low-pressure steam turbine will work at temperatures much lower than 100 deg. C. The temperature of 100 deg. C. was selected by me for quite other considerations. I had intended originally working at a much higher temperature, i. e., about 300 deg. C., but was deterred by the difficulty and expense of holding in such high pressures, though I may yet return to them, on account of the gain in thermodynamic efficiency.

On the other hand, there would be no serious objection to working at a temperature of 90 deg. C. or 70 deg. C.

A temperature a few degrees above 100 deg. C. was chosen because the pressure on both sides of the glass would be equal, i. e., there would be no tendency to breakage. Also, because with this slight excess above atmospheric pressure, there would be no leakage of air into the condenser.

I trust that the above will explain all points not understood. REGINALD A. FESSENDEN.

Sun Dials in the United States National Museum

To the Editor of the SCIENTIFIC AMERICAN:

The writer has given considerable attention in the past to the calculation of sun dials, and during the years 1909-1910 has constructed a number of aluminium and brass and presented the same to the U. S. National Museum, Washington, D. C., where they have been added to the collection of dials there in the section of time-keeping devices. These dials comprise: A universal dial, which operates in any latitude without change of gnomons and hour figures, provided the angles of the brackets that support it are changed to conform to the angle of the latitude of the place. Three horizontal dials, one for Nome, Alaska; one for Washington, D. C., and one for Panama; these illustrating well the changes that take place in the angles of the gnomons and the position of the hour lines in passing from high through intermediate to low latitude. A vertical dial calculated for Boston, Mass.; a reclining cross dial calculated for New Orleans, La.; a horizontal polar dial for latitude 90 deg., reading twenty-four hours; and a type of the ancient "noon mark."

It is possible, if the attention of the readers of the SCIENTIFIC AMERICAN were called to these and the other dials at the museum, some of them might feel an interest in looking them over when in Washington, as the subject of dials has attracted considerable attention in recent years.

Baltimore, Md. CLAUDE L. WOOLLEY.

The New Argentine Battleships

To the Editor of the SCIENTIFIC AMERICAN:

The September 10th, 1910, number came to hand during the latter part of October, and in said number there is a correspondence by a Mr. Harold M. Kennard *re* the Argentine and United States dreadnoughts, and in which he compares the two types of battleships.

It was my intention immediately on reading Mr. Kennard's letter to write you regarding same; but owing to the distance which separates us and the time required for a letter to reach you, I concluded that it would be useless, as I expected that it would be criticised and rectified long ere a letter from me might reach you, feeling sure that among the many readers of the SCIENTIFIC AMERICAN there would be at least several who would "see the joke," so to speak; but after receiving several of the following numbers, I find that apparently no one has noticed Mr. Kennard's error. The last paragraph of said letter I will quote entire: "Finally, I would say, as a matter of general interest, that I have learned on fairly reliable authority that the name of the second Argentine dreadnought is 'Acorazado.'"

This statement sounds strange, in view of the fact that only two weeks previous, in the August 27th number, on the front page, are cuts illustrating the two types of ships, one the "Wyoming" and "Arkansas," and above it the "Rivadavia" and "Moreno."

I fear your correspondent has been the victim of a practical joke as regards the "reliable authority" from which he received his information, and his statement has been the cause of considerable merriment in this city, as I wish to say, "as a matter of general interest," that the word *acorazado* is simply the Spanish for armored vessel or battleship.

The names "Rivadavia" and "Moreno" are of great men in Argentine history, and were given to two ships purchased from the Italian government and subsequently sold to the Japanese government, consequently it is only natural that the two new vessels should bear the names left vacant since the former two were disposed of. CHARLES W. CHUTE.

Rosario de Santa Fé, Argentine Republic.

An Opportunity to Catch an Asteroid with a Small Instrument

By the Rev. R. W. Roberts

KNOWING that many readers of the SCIENTIFIC AMERICAN are interested in astronomy, I venture to call attention to the fact that Vesta especially is easy of identification during February. On February 8th and 23rd Vesta is near Xi² Ceti and Mu Ceti, whose R. A. and Dec. are respectively as follows: 2 h. 23 m., 8 deg. 4 min., and 2 h. 40 m., 9 deg. 44 min., in both cases N. Dec. See table for ephemeris of Vesta on these days. I add also ephemeris of Ceres and Juno, though the latter will be more difficult of identification on account of its lower magnitude, being nearly of the tenth during February. Ceres is under the ninth, and should be an easy object. Vesta is about the eighth during this month. By consulting a star map, the proximity of Ceres to easily detected stars is easily noted.

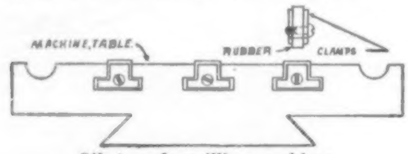
		R. A.		Dec.		
Date—	Mag.	H.	M.	Deg.	Min.	Sec.
Vesta.						
Feb. 1	7.96	2	16	N. 7	59	48
" 2		2	17	8	8	
" 3		2	18	8	16	
" 4		2	19	8	24	
" 5		2	20	8	32	
" 6		2	21	8	40	
" 7		2	22	8	48	
" 8	+	2	23	8	57	
" 9	8.05	2	24	9	5	
" 10		2	25	9	13	
" 11		2	26	9	21	
" 12		2	27	9	29	
" 13		2	28	9	38	
" 14		2	29	9	46	
" 15		2	31	9	54	
" 16		2	32	10	3	
" 17	8.14	2	33	10	11	
" 18		2	34	10	19	
" 19		2	35	10	28	
" 20		2	36	10	36	
" 21		2	38	10	44	
" 22		2	39	10	53	
" 23	+	2	40	11	1	
" 24		2	41	11	9	
" 25	8.22	2	43	11	18	
" 26		2	44	11	26	
" 27		2	45	11	34	
" 28		2	46	11	42	
Ceres.						
Feb. 1	8.58	1	23.4	N. 1	38	
" 9	8.64	1	31.9	2	56	
" 17	8.70	1	41.0	4	14	
" 25	8.75	1	50.6	5	33	
Juno.						
Feb. 1	9.79	13	30.8	5	27	
" 9	9.72	13	32.5	5	2	
" 17	9.66	13	32.8	4	28	
" 25	9.60	13	31.7	3	44	

The World's Wheat Crop

According to statistics which the International Institute of Agriculture at Rome published not long since as to the world's production of wheat, the comparative figures for the total production are as follows: United States, 200; Russia, 194; France, 98; British India, 77; Italy, 52; Hungary, 34, etc. As to the yield per acre of territory, the order is quite different, this being: Great Britain, 21; Germany, 19; France, 14; Austria, 13.2; Canada, 12.4, etc. The United States occupies the ninth place, with a figure of 9.2.

Oil Stops for Milling Machines

THERE are some milling machines that are not provided with oil pans, and that means a dirty floor around the machine. A simple oil stop can be inserted in the slot of the milling machine table, as shown in the sketch; a piece of rubber packing is cut to just the size of the T slot in the table, and two pieces of 3/16-inch sheet metal are cut about 1/32 inch smaller than the T slot. One plate is drilled and tapped for a ¼-inch screw, while the other plate is drilled to suit the body of the ¼-inch screw. The rubber is placed between the two plates and placed in the T slot. After the stops are placed in position, the screw is tightened up, thus causing the rubber to expand and fit tightly around the T slots in the machine. These oil stops will be found very handy around the machine shop.



Oil stops for milling machines.

To Sharpen a Bit

By W. D. Graves

PRACTICALLY all of the numerous wood-boring tools work on essentially the same principle as does the common spur bit; so a clear understanding of what is required in order to insure good work with one of these will prevent one from going far astray in sharpening any of the others. In order to arrive at such an understanding, one must note carefully each of the cutting members, for there are two, and consider its function.

The worm, the office of which is only to guide and steady the cutters, rarely needs attention; but, in case it has been damaged by contact with metal, it may sometimes be somewhat bettered by a little careful work with a fine three-cornered file. With ordinary use, without abuse, the worm will remain in better shape than any hand filing can put it in, till the spurs and lips are worn beyond redemption. Hence any repair should be very conservatively undertaken, always and only with a view to bringing the part as nearly as possible to its original form.

In the ordinary practice of filing a bit, the spur should receive attention first. This should be filed no more than is required to bring it to a keen edge, with the angle about the same as on a new bit. All such filing should be done on the inside, as in Fig. 1, except in case gross abuse has led to the bending of the end outward. In such case the outwardly bent part (*but no more*) should first be filed off. One should guard against filing the part any more than is absolutely necessary; for it is usually the shortening of the spur that renders a bit worthless. It is by having this spur sufficiently long and keen to make a clean cut before the lip begins to raise a shaving, that a smooth hole is insured. It is this spur that differentiates the bit from an auger; its place being taken, and its work being but ill done, by an upward turn of the outer side of the lip in the case of the latter tool.

Having sharpened the spur, attention should next be given to the lip. The action of this is like that of a chisel; or, in that it is guided and restrained, more like that of a plane iron. Care should first be taken to give it sufficient "clearance"; by which it is meant that, after the cutting edge has acted, there should be no part of the metal which will touch the bottom of the hole. This is a very important matter, and one which is often overlooked. Referring to the sketch, Fig. 2, the line *AB* is supposed to represent the bottom of the hole, while the irregular line is the outline of the much magnified and dulled edge of the lip. This edge should be filed to approximately the shape shown by the dotted line *bc*, making sure that there shall be a sharply defined angle *Abc*. This angle may be very acute, but it must be enough to make sure that there *is* an angle. One should do no more filing than is absolutely necessary here—in fact, it is not usually necessary to do any at all—but, after a proper bevel is insured by filing, as in Fig. 3, the bit should be turned to the position shown in Fig. 4, and the lip brought to a cutting edge.

In filing a bit one should always use a file with a "safe edge," i. e., with one edge smooth, in order to insure his filing only that part to which he is giving immediate attention. A file like that shown in the photograph is made for the purpose; but one can do the work quite satisfactorily with a square file, one side of which has been ground or left smooth. Lacking this, a three-cornered file, two corners of which have been smoothly ground off at right angles with the face used, will do the work as well as any. Of course, a file without a "safe edge" may be used, but with such a one the utmost care will scarce suffice to avoid bungling the job.

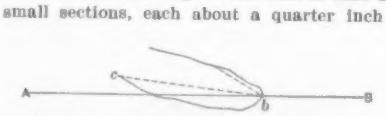


Fig. 2. – Magnified view of a dull lip.

Fig. 1. – Sharpening the spur.

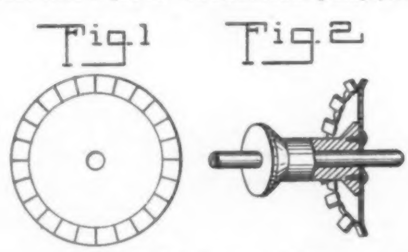
Fig. 3. – Filing the lip.

Fig. 4. – Finishing the lip.

Grooved Pulley for Experimental Work

By Edward Tiede

IN working out small models of machinery and in experimental work generally, small grooved pulleys are often required. To obtain such pulleys, a mold of the proper size and shape is usually made, into which a suitable metal is cast; a process which, though satisfactory, involves the use of a lathe and considerable preliminary work.

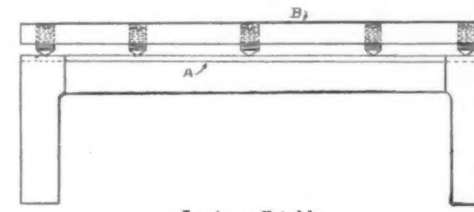


Improvised grooved pulley.

A very serviceable and, for most purposes, sufficiently accurate, grooved pulley can be made without any elaborate preparations in the following manner: Take a piece of sheet metal, and with a pair of dividers mark two circles on it about a quarter of an inch apart; cut around the outer circle, thus forming a round disk. The edge of the disk is next divided into small sections, each about a quarter inch wide. Cut the sections apart to the inner circle, and then bend the sections apart, one to the right and the next to the left, and so on all around the disk, being careful to have all of the same angle. This done, the pulley is ready to be mounted. An ordinary wooden spool makes a satisfactory hub for a pulley of this kind. Fit a shaft snugly into the hole of the spool, and drill a hole in the exact center of the pulley, just large enough to permit it to slide over the shaft. Slip the pulley over the shaft and against the spool, and fasten it with small brads or screws. If ordinary care is used, the pulley will run quite true. A pulley of this kind has the advantage of retaining a good grip on the belt, reducing slipping to a minimum. It may be added that if a loose pulley is wanted, a piece of tubing fitted into the spool as a bushing, instead of the shaft, will answer the purpose. The drawings attached hereto show in Fig. 1 how to lay out the disk, and in Fig. 2 how the parts are assembled.

Laying-off Table

A SMALL laying-off table is a very handy thing to have around a small shop. It is expensive to make a laying-off table by building it up from the ground, but the table here illustrated is inexpensive in comparison with those that are built on a foundation.



Laying-off table.

An ordinary table is made as shown. It is, of course, built to suit the cast-iron surface plate *B*. There is a machine steel strip, shown at *A*, ¼ inch thick by 2 inches wide, placed around the top of the frame of the table. The frame is cut down to allow the strip to come flush with the top. A number of ¾-inch holes are drilled and tapped around the edge of the face plate, as shown; the number is determined by the size and weight of the surface plate. Set-screws are placed in the holes. At one end the set-screws have a 60-degree point. When the face plate is placed on the table, the set-screws are run through, and the cone points will seat themselves in the strip *A*. These screws serve to level up the surface plate. When the table has been moved around on the floor and is not level, the set-screws may be adjusted to suit the floor, bringing the face plate level.

Shop Notes

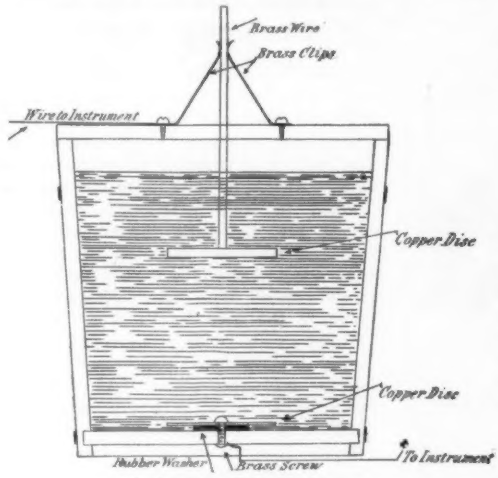
To Anneal High-speed Steel.—High-speed steel is annealed by heating, not by cooling. It does not require more than twelve hours for a piece 2½ by 10 inches to cool. There are a great many ways in which this steel can be annealed. In place of a crucible use a cast-iron box and some cast-iron shavings from a planer or lathe, and pack your work in this. If you have not the shavings or box, take a gas pipe and pack the work in charcoal or ashes, dirt, clay, anything that will not burn on the work to be annealed. Heat it for seven hours, running the heat as high as 800 deg. C.; hold the heat at this degree at least five hours, then raise it to 900 deg. C. (cherry red); then shut off your fire and close your furnace door. Take out the steel after twelve hours. Steel treated in this way will be as soft as machine steel.

Softening Hard Iron Castings.—It happens quite often that one comes across extremely hard cast-iron castings that refuse to be drilled or machined. Some castings that broke by simply center-punching them, were made by the following method as soft as common cast iron, and drilled as easily. The castings referred to were very thin and considerably warped. They were intended to clamp a door tightly, but they invariably broke when pulling up the bolts. There being a wrought-iron heating furnace in the shop, it was converted for the time being into an annealing plant, only using different absorbing or annealing material. To do this, a supply of old sheet-iron boxes was procured from the junk pile, a supply of burned molding sand, that was perfectly dry, from the foundry, and a few sacks of fat pine chips from the planing mill. A layer of molding sand was placed in the bottom of each box, and on this about one inch of pine chips, and the castings on top of that, care being taken to keep them from touching each other or the sides of the box. More pine chips were then packed on to a depth of about two inches, and the box was then filled with the molding sand. After this the box was placed in the furnace and sub

jected to a low heat for twelve hours. When withdrawn and allowed to cool, the castings were found to be perfectly soft and gave no further trouble.

A Home-made Rheostat

To make a simple rheostat, procure a small wooden pail or bucket. After it is dried thoroughly, give the inside a good coat of melted paraffin. Cut two disks of copper, one and three inches in diameter respectively. Clean the disks thoroughly by scouring with emery cloth. Fasten the large disk to the bottom of the pail with a one-inch round-headed brass wood screw. Place a rubber washer between the disk and the bottom before the screw is driven in, to prevent the acidu-



A rheostat of simple form.

lated water from attacking the screw. A little solder will make a good contact between the two metals. Then solder the one-inch plate to a straight brass or copper wire, about No. 10 B.W.G., and eight or ten inches long—at least three inches longer than the pail is deep. Make a wooden support long enough to reach across the pail, and drill a hole in the center large enough to let the wire slide through. Bend two pieces of spring brass to the shape shown, and fasten with screws, so that the free ends grip the rod and hold it in position, and at the same time form a sliding connector. The wire leading from the top should be soldered to both clips, thus reducing the resistance at this point. The rod is pushed through the hole, and the wooden strips are nailed to the pail.

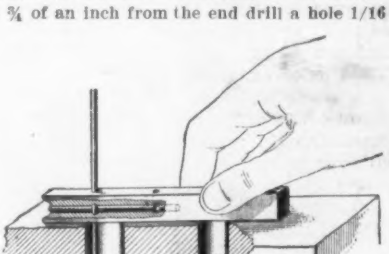
A solution is then made to fill the pail to within one inch of the top, composed of twenty parts of water and one part sulphuric acid.

When the upper disk is withdrawn from the solution, the circuit is broken; but as it is pushed down toward the bottom, the resistance decreases until the two disks come in contact. Thus the quantity is regulated from nearly zero to full strength. The smaller the quantity of acid mixed with the water, the greater will be the resistance, as pure water is not a very good conductor.

This is a very cheap rheostat, and readily built by anyone at home in a short time. It is adjusted within great limits, and has a large capacity; and if a heavy current is passing, the heat generated will be readily absorbed by the solution.

Simple Depth Gage

A simple depth gage can be made as follows: Take a piece of steel 5/16 of an inch thick and ½ inch wide and about 3½ inches long. Drill a ¼-inch hole lengthwise in the end to one side of the center line. About ¾ of an inch from the end drill a hole 1/16 inch



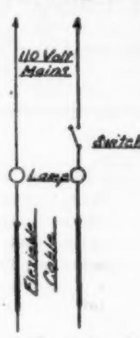
Simple depth gage.

in diameter, at right angles to and cutting into the first hole, one-third of its diameter. Now this hole drilled lengthwise is plugged with a pine plug. The hole at right angles in the steel receives the gage wire, and when inserted compresses the pine plug where it crosses. This gives the desired friction, which will hold the gage wire any place that is required in gaging the depth of an aperture. Mr. Clark, the designer of this gage, has used one twenty years without renewing the pine plug.

Electric Torch Lighter

By Howard M. Nichols

Because of the carelessness of many workmen, it is desirable to eliminate matches from factory buildings. The electric torch lighter described below was designed with this end in view. The accompanying diagram shows the method of making the connections. A line is run from the 110-volt lighting mains to a small board erected near the blow-torch. On this board are mounted two incandescent lamps and a switch. One lamp is in series with each side of the line, as shown. Binding posts are provided, and leads of flexible cable, long enough to reach the torch, are connected to them. The ends of the cable have short pieces of stiff wire soldered to them. When it is desired to light the torch, the switch is closed, the gas is turned on, and the two free ends of the cable are brought together and then separated in front of the torch, the resulting spark firing the escaping gas.

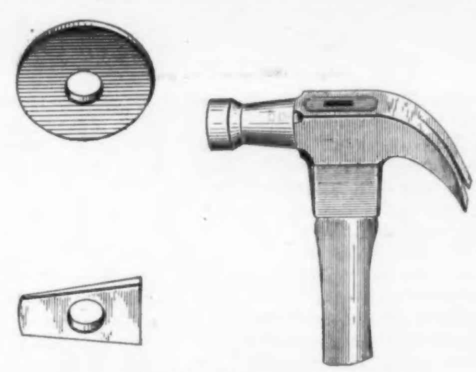


Electric torch lighter.

The size of the spark can be varied by using different sizes of lamps. The larger the candle-power of the lamp the stronger the spark will be. It should never be attempted to work this system without the lamps in circuit, as a short circuit, that would make a big flash and possibly burn the operator, would be the result of such an attempt.

Fastening a Hammer Head to the Handle

The following method of securing hammer heads to handles may prove useful: It consists in taking an ordinary washer, cutting it away at opposite sides, and then beveling it to form a wedge. When this is driven into the end of the hammer handle it is held firmly in place by the fibers of the wood that are

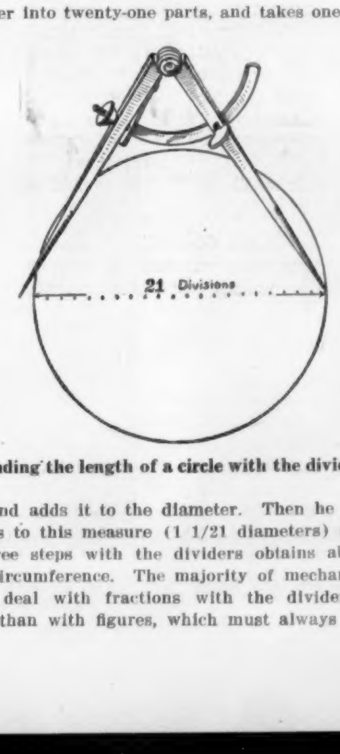


Hammer handle wedge made of a washer.

forced into the original washer hole in the center of the wedge. This idea is not offered as something new, but the average handy man has probably not heard of it, and may find it a very serviceable kink.

Finding the Length of a Circle

The mechanic's handy method of finding the length of a circle is as follows: He first divides the diameter into twenty-one parts, and takes one of these



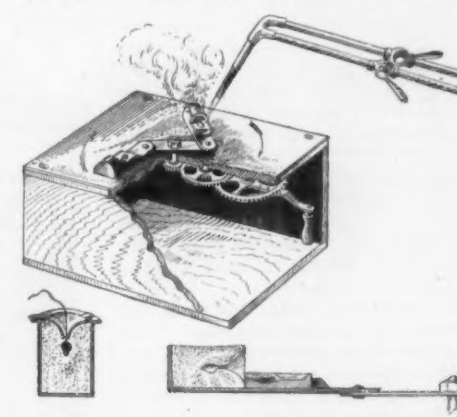
Finding the length of a circle with the dividers.

parts and adds it to the diameter. Then he sets the dividers to this measure (1 1/21 diameters) and taking three steps with the dividers obtains about the exact circumference. The majority of mechanics prefer to deal with fractions with the divider points rather than with figures, which must always be used in this calculation. The measurement obtained in this way is close enough for most kinds of work.

Casting Gold Centrifugally

By Albert F. Bishop

Dentists have a very clever method of making solid gold castings. A train of gears is employed, which revolves a spindle that carries two jointed arms. The outer end of one arm has an inclosure where the little mold is placed, while the other arm carries a counterbalance. Just in front of the mold is a fireclay block, hollowed to receive the gold which is melted with the blowpipe. The gearing is rapidly worked by hand, revolving the melted gold, which is forced very quickly into the mold. Owing to centrifugal force, a very solid and clean-cut casting is made, which is free from blowholes. In mak-



Dentists' method of making solid gold castings.

ing the mold, it is necessary for the dentist first to make a pattern. This is done by filling the cavity in the tooth with wax. A wire attached to the pattern holds it in place while the clay mold is being made, as shown in one of the figures. When the mold is complete, the wax is melted out. Another figure shows a section of the mold as when placed on a rotary arm, also the block in which the gold is melted.

How Crown Brasses are Turned

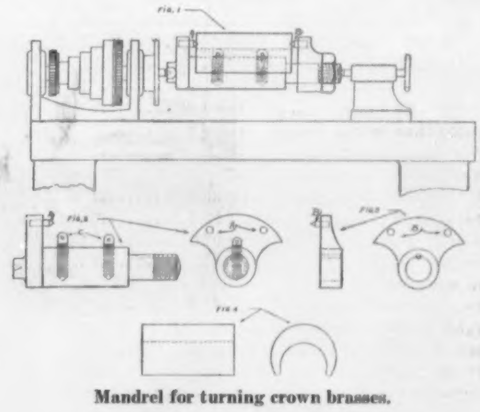
By H. D. Chapman

The accompanying drawing shows the way in which a mandrel can be made and the way it is used for turning crown brasses for driving boxes on locomotives.

Owing to the shape of these brasses, it makes a rather hard job to chuck or clamp the brass for machining, the brass being crescent-shaped in cross section, as shown in Fig. 4. Fig. 1 shows the mandrel and the way in which the work is clamped ready for turning. Fig. 2 shows the end and side view. It is made of machine steel, and is simple in construction. Fig. 3 shows the side and end view of the collar that slides over the end of mandrel. The key prevents the collar from turning.

There are two 5/16-inch holes drilled in the head of the mandrel to receive two center pins *A*, which are made a driving fit. The pins are allowed to project as shown. Two pins *B* are made and driven in the collar, as shown in Fig. 3.

There are two studs *C* which are screwed in the



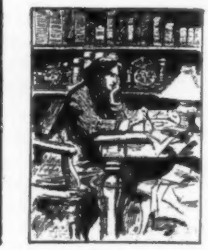
Mandrel for turning crown brasses.

mandrel as shown. On these studs the crown brass rests, and they may be adjusted to suit different sizes of brasses. When the brass is placed on the mandrel for machining, the nut on the end of the mandrel is screwed up, and the pins *A* and *B* will sink themselves in the metal, holding the work rigid for machining.

While this work is of a rather special character, it may suggest methods that will be found useful in other problems of lathe work.

The Inventor's Department

Simple Patent Law; Patent Office News; Inventions New and Interesting



A Pneumatic Cushion Substitute for an Automobile Spring

THERE has recently been invented by a California mining engineer a novel substitute for springs and shock absorbers on automobiles. This is a pneumatic cushion which appears to have advantages, because it permits the use of solid tires.

The inventor of this new device has found it possible not only to construct a pneumatic shock absorber, but so to arrange this that it takes the place of the spring itself, while at the same time preventing any rebound.

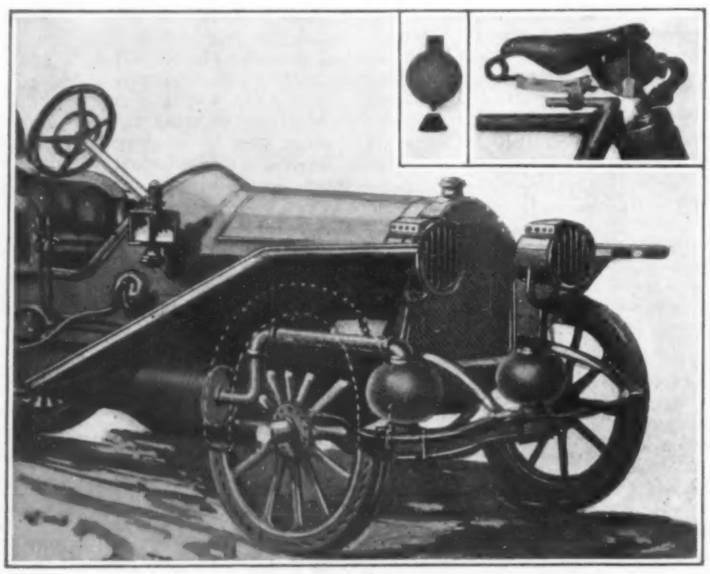
In its present state this pneumatic cushion consists simply of a round rubber bulb six or eight inches in diameter, having an open neck at its upper end, and a small projection at its lower. This projection fits into a hole in a conical wood block that is secured to the axle of the automobile, while the neck of the bulb is set into a pipe fitting attached to the body of the machine. This pipe, of about 1½ inches diameter, connects to a tank having a capacity of 2,000 cubic inches. Four such bulbs replace the springs of an automobile. In fitting them to a car, the leaves of the springs are removed with the exception of the outer heavy leaf, which is used for steadying purposes. All four tubes are connected by separate pipes to the tank.

The action of the bulb is as follows: When a wheel of the car passes over an obstruction, the bottom of the bulb resting upon the cone-shaped block is pushed inward, and the surface of contact of the bulb with the block is increased. The heavier the blow, the more the block sinks in; consequently, there is a continuously increasing supporting area within the bulb upon which the air acts, the air being under a compression of about 20 pounds to the square inch in the bulb, the pipe line, and the tank. As a result of the increasing flattened area in the bottom of the bulb under a heavy shock, there is a cushioning effect that increases with the blow, and when the initial shock has been absorbed, there is no rebound, since the air in the bulb, piping, and tank has not been appreciably compressed. The cushion acts upon the same principle as the pneumatic tire, since the supporting area is increased when the bulb is flattened, in much the same way as it is with the tire; but in this case there is no increase in air pressure, owing to heating of the air, and consequently no liability of bursting.

The air cushion makes it possible to use solid tires upon all commercial vehicles no matter what the size, as well as upon pleasure cars where it is desired to dispense with the costly pneumatic. The life of a good solid tire is easily double that of a pneumatic. For heavy work eight 12-inch bulbs, using an air pressure of 80 pounds and deformed to 8 inches vertical diameter, will sustain a weight of 15 tons and have a maximum carrying capacity of 24 tons, while 16-inch cushions will carry minimum and maximum loads of 30 and 48 tons, respectively. The rubber bulbs that have been tested in actual use are 8 inches in diameter with a 1¾-inch orifice at the neck. They are made up of six layers of canvas imbedded in a ⅝-inch thick rubber wall. They have shown no signs of wear in a 5,000-mile test.

The minimum load that is placed upon four 8-inch cushions is 1,400 pounds, with an air pressure of 30 pounds per square inch and a total contact area of 48 square inches at the bottom of the bulbs. The maximum load these 8-inch bulbs will stand with the same air pressure, is 4,320 pounds. This would increase the contact area to 144 square inches, and flatten out the bulbs to about 5 inches vertical diameter, but there would still be two or three inches for further vertical movement in case of a sudden shock or blow. The air pressure in the bulb determines the strain upon the walls, and as this air pressure never increases perceptibly, it can be seen that the strain is not very great.

That this pneumatic cushion can be applied to any vehicle can be readily seen. One of our illustrations shows it in use on a motorcycle saddle in place of springs.



A pneumatic cushion substitute for an automobile spring.

"Uncle Sam's" Automatic Dampening Machine

By Thomas D. Gannaway

YOUR "Uncle Sam" is the possessor of the first and only automatic dampening machine for dampening paper for plate printing in existence today. Although plate printing was invented in Italy nearly four hundred years ago, but little change has been made in it since. The plate printer has had many of the same difficulties to contend with all these years in his effort to produce the best results from the engraved plate. As time has passed, great progress has been made in the art of engraving plates from which to print. The engraver has become more skillful in producing smaller and more artistic lines in his plate, thus making it still more difficult for the printer to reproduce the engravings upon paper. The greatest obstacle he has met with in all his career has been to get his paper in the proper condition for printing from an engraved plate. Plate printing is of such difficult nature that all work of a particular character (such as the printing of paper currency) has to be done by hand.

The printer, after inking his plate, takes a cloth and wipes it until the ink is all apparently wiped off; then he polishes it with his naked hand, thus seeming to remove every particle of ink he put upon it. But down in the hundreds of very fine depressions the ink still remains, and it is this ink that the printer must get on his paper. In order to do this satisfactorily, the paper must be wet and mellowed to a certain condition. If the printing is to be quite uniform, which is very essential in the case of paper money, all the sheets of paper must be moistened exactly alike. Here is where the plate printer's real difficulty lies. If the sheet is mellowed down to the right condition, it will pick up the proper amount of ink, and the print will be perfect; but should it be too soft, it will get too much ink, and the results are usually disastrous. On the other hand, if it is too dry, it will not take up

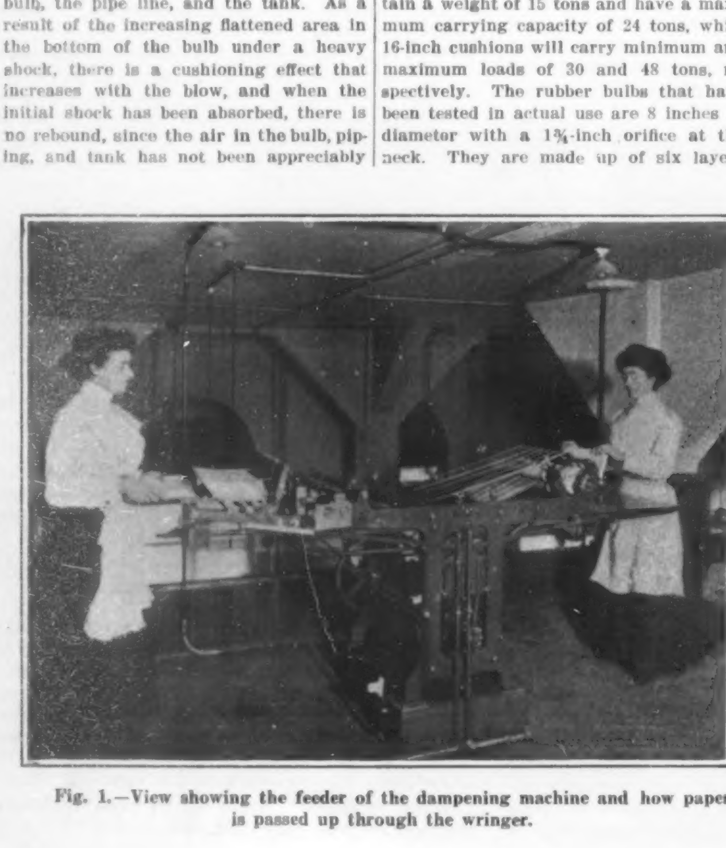


Fig. 1.—View showing the feeder of the dampening machine and how paper is passed up through the wringer.

Fig. 2.—How the paper passes from the feeder of the dampening machine down into the water and how it is automatically stacked on edge.

enough ink, and the print will be too pale, and hence useless.

Hundreds of thousands of dollars have been spent by private concerns in trying to overcome this seemingly unsurmountable obstacle. Some of the most skilled mechanical minds and the greatest geniuses in the world have tried to overcome this difficulty and failed. It remained for Mr. Joseph E. Ralph, Director of the Bureau of Engraving and Printing, and Mr. Benjamin Stickney, his mechanical expert and designer, to be the first men to reach this goal. Mr. Ralph, after reaching the conclusion that the paper could be wet by machinery, and at the same time more perfect results obtained in that way, called in Mr. Stickney and discussed the plan with him. The latter, under the direction of Mr. Ralph, set his mind to the task about one and a half years ago to work out the mechanical features of a machine by means of which all sheets of paper to be used in making money could be wet every one alike, and then put in exactly similar condition for the plate printer. He could not devote his whole time to this one idea, as there were other mechanical features of his work which had to be looked after. Finally, having completed his designs, he submitted them to Mr. Ralph, who ordered the machine built; and consequently in the government's big plate-printing plant to-day, stands one of the greatest machines known to this industry, and yet one of remarkable simplicity.

In order to convey a better idea of the many extraordinary qualities of this wonderful machine, I shall first describe the best approved method of wetting paper for plate printing at the time of the advent of the automatic dampening machine.

In what is known as the wetting division of the Bureau of Engraving and Printing, a large number of men are employed to dampen about 400,000 sheets of paper per day. They use boards a little larger than the sheets of paper for a starting base. On this base is placed a wet cloth; then twenty sheets of paper are placed on the cloth, and another wet cloth is laid on top of these. Next comes another twenty sheets and another cloth, and so on until the stack contains 1,000 sheets of paper and a corresponding number of cloths. After being stacked the sheets are taken away and put under a slight pressure for 24 hours.

When taken out of the press, naturally those sheets which were closest to the cloths contain more water than those in the center of each bunch of twenty sheets. Each such bunch has to be taken out and split in the middle, and the two wet sides turned together and repacked with a new set of wet rags. The sheets are then put back into the press for another twenty-four hours. The cloths after use must be washed before they can be used again. They take up a great deal of the animal matter contained in the sizing which was put on the paper by the manufacturer, and unless they are taken out at the proper time and well washed, they will sour, thereby injuring the quality of the paper. The men who moisten this paper must, before entering the work room, don some old clothing, as it is impossible to escape being soiled. Notwithstanding all of this care and the trouble of handling the paper twice, the wetting is not thoroughly uniform, as will be readily understood.

When a sheet has received the proper amount of moisture, it has expanded ½ inch. Now suppose the printer gets three sheets of paper. One of them has the proper amount of moisture in it, and has expanded ½ inch; the second is too wet, and has expanded, say, ⅝ inch; the third one has not received enough moisture, and consequently has expanded only about 3/16 inch. They are all printed from the same plate, and when they are thoroughly dried they will have contracted to their natural width; therefore there will be a variation of 7/16 inch in the size of the notes printed on these three sheets. Also, the ones which were too wet are now too dark in color, and the ones which were not wet enough are too light in color. Thus it can be seen that the printing is not perfect, and cannot be made so under these circumstances.

With the automatic machine it is altogether different. As will be seen from the illustrations, this machine is quite compact. It requires but one attendant, with one assistant giving one-half her time.

The automatic feeder, which feeds from the bottom of the stack, will operate successfully under a stack of three thousand sheets, thus enabling the attendant who looks after the feeder to care for two machines at once. This feeder, which is a remarkable mechanism itself, is one of Mr. Stickney's inventions. In Fig. 1, to the left, you can get a good view of it. It slightly raises the stack of paper, and at the same time slips the bottom sheet (and only one at a time) just far enough for it to be caught between two rollers. These two rollers pass it onto a set of canvas belts and under a corrugated roller (Fig. 2, to the left) to the point where it is caught between two sets of canvas belts (Fig. 1, near the center). By these it is carried down through running water contained in a shallow basin in the center of the machine. They also carry it out of the water up to two squeezing rollers made of rubber. (Fig. 1, to the right of the center of the machine.) These rollers are adjusted by means of set-screws (which may be seen in either illustration) so as to leave the required amount of water in each sheet. The paper then passes over the large cylinder just to the right of the wringer, and is automatically caught and placed on its edge, as shown in Fig. 2. If for any reason a sheet is not properly placed on its edge, it is at once removed by the attendant and placed in the stack to her right. Otherwise she lets them remain in the machine until the pack contains about one hundred sheets, then she removes them to the stack.

The attendant at the other end of the machine receives the paper in packages of 1,000 sheets each. When she has placed 1,000 sheets upon the feeder, she puts in a sheet of another kind of paper as a marker for the one receiving it at the other end of the machine; thus the sheets are kept in packages of 1,000 each.

It has been ascertained that the required amount of water to properly mellow 1,000 sheets of paper is 5 pounds. A thousand sheets of dry paper weigh, on an average, 12 pounds and 6 ounces. By weighing the paper before it is put into the machine and again afterward, it is easy to ascertain just how much water is left in it. This is controlled by the adjustment of the wringer. With this method all the sheets are wet exactly alike, each individual one containing 35 grains, or 2/25 of an ounce, of water when it leaves the machine.

The paper is carried from here in packages of 1,000 and placed in a humidor for twenty-four hours or longer if desired, or it may remain there even for a week without injury. The "humidor" is merely an air-tight case, where the paper is put to properly mellow it for printing.

The dampening machine, after being properly adjusted, will run indefinitely, automatically feeding, dampening, and packing the sheets. It has a capacity of 48,000 sheets in seven hours. Three attendants can operate two machines, and the work is quite clean, in contrast with the old process.

Another very important feature about this machine, and one which will interest every taxpayer, is the saving which it effects. Under the old method it cost the government 52 cents per thousand sheets to dampen the paper, while with this machine it can be done for 14 cents per thousand. This makes a saving of $18.24 per day on each machine turning out 48,000 sheets, making a total of about $42,000 per year.

Changes in the Patent Office Staff

Edwin Lyon Chapman, Examiner of Trade Marks and Designs in the United States Patent Office, died at his residence in Washington, D. C., January 18th, 1911.

Mr. Chapman's term as Examiner of Trade Marks was undoubtedly the most remarkable in the history of the Patent Office. He was examiner in charge at the time of the passage of the Trade Mark Act now in force, and was the presiding genius in organizing, not only the business methods incident to the inauguration of the registration of trade marks under the new law, but was also responsible in large part for the procedure and practice found necessary in carrying out the purpose of such law.

He was a man of much force, had a strong intellectual grasp of the legal problems involved, was untiring in his energy, was possessed of great creative faculty and won the admiration of all who appreciated his sterling worth as an official.

Personally Mr. Chapman had many lovable qualities, and strong attachments were formed between him and his intimates.

He was a native of Ohio, but lived most of his early life in Monroe, Michigan. As a young man he entered Cornell University, from which he was graduated in 1881. After studying law and practising for a short time at Monroe, his Michigan home, he accepted a position in the Patent Office, where his real life work was done, and where his strong individuality has left an enduring mark among the records of the office.

Mr. Chapman is succeeded by Mr. John H. Carnes, who has been promoted from first Assistant Examiner to Principal Examiner, and assigned to take charge of the division of trade marks and designs.

Mr. Carnes was born at Jersey City, entered Rutgers College, New Brunswick, N. J., in 1891, and was graduated from the civil engineering course in 1895. He practised civil engineering for several years, and entered the Patent Office in December, 1900. For a period of five years he served in various examining divisions, and for the past five years has been in the Interference Division, of which he was ranking assistant at the time of his recent promotion. During his term of service in the Interference Division, he handled most of the trade mark interferences, and thus became familiar with the substantive law of trade marks and *inter partes* procedure in trade mark contests. He is a trained lawyer, a member of the bar of the Court of Appeals of the District of Columbia, and comes to his new office with an experience that eminently fits him for his responsible duties.

The Patent Office and trade mark public are equally to be congratulated on his acceptance of the appointment.

Safety Devices.—In no way can invention be more profitably employed than in providing means for the protection of life and limb in the operation of power-driven machinery. The liability of an employer for injuries to an employee in certain cases is such as to cause him to be diligent in seeking all safety devices that can be used to advantage on his machines; and invariably if the choice is to be made between two machines, otherwise equal, the safe machine will be given the preference, and manufacturers should pay more and more attention to this feature of their products.

Brief Notes on Inventions

An Inventor in Congress.—The Hon. Gustav Küsterman of Wisconsin is thought to be the only member of the House Committee on Patents who has been granted patents for inventions. He, because of being a patentee, had a special claim to a position on the committee. He has served on the committee through the 61st Congress and his term, together with those of a number of his associates on the committee, will expire March 4th, 1911.

Principal Examiner A. G. Wilkinson.—Mr. A. George Wilkinson, Principal Examiner of Division 20, of the United States Patent Office, was appointed July 1st, 1864, entering as an assistant examiner. He is the dean of the Examining Corps, having been promoted to the office of Principal Examiner on May 15th, 1868. Mr. Wilkinson has seen many Commissioners come and go, and has been familiar with the progress of the Patent Office during the past half century. Mr. Wilkinson hopes to round out a full fifty years of service, when he trusts a grateful government will be operating a retirement measure for faithful employees.

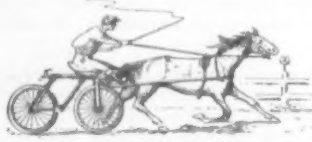
The Division of Interferences.—Prior to 1870 interference proceedings in the United States Patent Office to determine which one of two or more rival inventors claiming the same patentable invention was the first inventor, were instituted, heard, and decided by the primary examiner of the division having charge of the particular case. The office of Examiner of Interferences was created by act of Congress July 8th, 1870, and Joseph Adams was the first Examiner of Interferences. With the development of the patent system and the enormous increase in the applications for patents, many conflicts arise and the interference division is among the busiest and most important departments in the Patent Office.

The Date of Conception of an Invention.—The inventor is the poet of things, the realistic rhymster who reaches out into the realms of fancy and brings back, not a new verbal expression, but nevertheless a distinctly new idea. Just as the poet's idea is as nothing until fittingly expressed, so the inventor's idea is in vain until he has embodied it in some physical form. This is the foundation of the legal limitation of the inventor's conception of his invention to the time when he first puts it into tangible shape. As one decision says, "It is therefore the formation in the mind of the inventor of a definite and permanent idea of the complete and operative invention as it is thereafter to be applied in practice, that constitutes an available conception within the meaning of the patent law." The date of conception of the invention, completed as above indicated, is, when followed by diligence to a practical completion of invention, of paramount importance in case of a contest.

The Board of Examiners-in-Chief: A Suggestion.—The Board of Examiners-in-Chief of the Patent Office, consisting of but three members, is placed in a peculiarly embarrassing position in case one or more of its members becomes incapacitated by sickness or otherwise. This is likely to occur at any time, and provision should be made whereby some Primary Examiner or other Patent Office official might be designated by the Commissioner to sit temporarily as a member of the Board. This would doubtless require legislation, but necessary authority should readily be granted by Congress. This would not only facilitate the work of the Board in case of absence of some of its members, but would give the official so called upon a new experience and a new point of view which should prove beneficial, and would also permit the assignment of some official, expert in the specialty of the absent member of the Board.

Patent Oddities

Bicycle Trotting Sulky.—In order to make a sulky that will be very light, and one in which the weight of the driver will be entirely removed from the shafts, an inventor has adopted a bicycle design. The two wheels of the sulky are mounted in tandem, and are supported in a frame of the bicycle type, which is not only very light, but is also very strong. The



Bicycle trotting sulky.

shafts of the sulky are connected to the steering post of the front wheel of the bicycle, so that the wheel will follow the horse around curves and sharp turns. The tractive effort required with a vehicle of this sort will be practically negligible.

Shaft-centering Device.—Heretofore in order to find the center of a line of shafting, it has been the common practice to suspend a plumb-line from the edge of the shafting and then to caliper the shafting and measure back from a point on the floor under the plumb-line a distance equal to the radius of the shaft. This process is rather slow and liable to be inaccurate. A much simpler method is provided by the device shown in the

Shaft-centering devices.

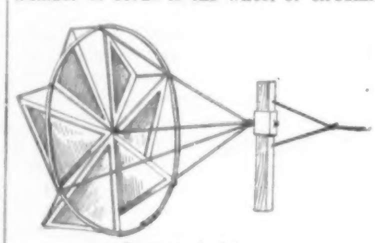
accompanying engraving. It consists of an arc shaped member furnished with a pair of anti-friction rollers which are adapted to ride on the shafting. A plumb-bob is suspended from the ends of the arced member. As a result of this arrangement the rollers move to one side or the other until the plumb-bob centers itself directly under the shafting. The line to which the plumb-bob is attached may be adjusted to any desired length so that the plumb-bob will just reach the floor.

Pencil-sharpening Attachment.—A convenient little device that may be applied to a pencil, is illustrated in the accompanying drawing. This device normally serves as a finger hold, but contains a blade which may be moved into active position to sharpen the pencil. The blade

Pencil-sharpening attachment.

is mounted in a U-shaped frame, containing a slot through which the point of the pencil passes when bringing the blade to active position. This U-shaped frame serves as a guard for the blade, and obviates all danger of cutting one's fingers or tearing the pockets.

Gyroscopic Kite.—A peculiar form of kite has recently been invented, which consists of a small windmill. This is revolved at high speed by the wind and, according to the inventor, produces a gyroscopic effect on the frame of the wheel, making the kite ride steadily in the air. The kite string is attached to a short bar, through which passes an eye-bar. This is arranged to swivel freely. Connected to the eye-bar by means of a number of cords is the wheel or circular



Gyroscopic kite.

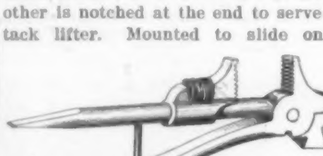
frame of the windwheel, that carries the vanes. These vanes are triangular in shape, with one side secured to a spoke of the wheel, while the outer corner of each is connected by an elastic band to the wheel rim. The elastic band permits the vanes to give in proportion to the strength of the wind.

Hair-drying Fan.—In order to permit of fanning the hair after it has been washed, a California inventor has devised a curious type of fan, which we illustrate in the accompanying sketch. The fan consists of a flexible leaf secured to a bow-shaped frame, which in turn is pro-

Hair-drying fan.

vided with a pair of handles pivoted to it. The fan may be swung over the head, as shown, and will direct a current of air toward the head from behind as well as from in front, without diffusing or dissipating the air as in ordinary fans.

Combination Tool.—The accompanying illustration shows a combination tool recently invented, which may be considered typical of this class. It consists of a pair of pliers, with the jaws shaped to provide an ordinary nipple wrench, and containing a depression near one end for the head of a wire nail when pulling such a nail. One of the handles of the plier is flattened to form a screw-driver, while the other is notched at the end to serve as a tack lifter. Mounted to slide on the



Typical combination tool.

screw-driver handle is a wrench jaw, bearing the usual worm that engages a thread or rack in the screw-driver handle. The other member of the pliers carries a fixed jaw. One advantage of this arrangement lies in the fact that after the jaws have been set, they may be tightened on to the work, by pulling the handles of the plier apart. Owing to this arrangement the tool may be used as a pipe wrench. One of the jaws is further provided with a hammer head to permit of driving small nails and tacks, while there is the usual notch in each member of the pliers, to be used for clipping wire.

RECENTLY PATENTED INVENTIONS.

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

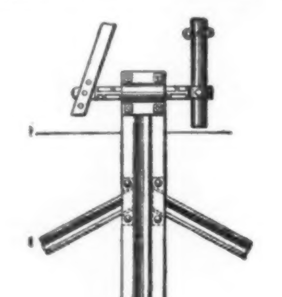
The weekly *Index of Patents* issued by the United States Patent Office will be found in the *Scientific American Supplement*.

Electrical Devices.

ELECTRIC CIGAR-LIGHTER.—V. E. EKTROM and T. G. BOARDMAN, Tomahawk, Wis. It is the purpose of this invention to so construct a cigar lighter that the current can be transformed or stepped down to a lower voltage and increased amperage, enabling the use of a much coarser and stronger wire, of entirely less expensive material, which will offer a greater heating surface, and will come to the glowing point in the shortest possible space of time.

Of Interest to Farmers.

ANCHORING BASE FOR POSTS.—PERCY T. BAILEY, Newport, R. I. The accompanying engraving illustrates an improved anchoring base for fence posts and the like, and provides particularly a means for securing auxiliary



ANCHORING BASE FOR POSTS.

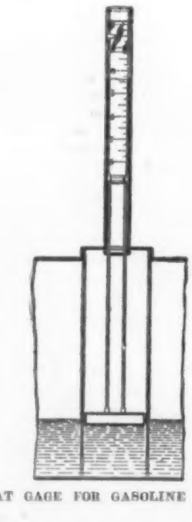
anchoring arms to the post or central spike. The central spike is formed of sheet metal corrugated lengthwise to give it the necessary rigidity. The anchoring arms are V-shaped in cross section, and are secured to the spike by means of metallic fasteners in the form of loops that fit snugly over the anchoring arms.

Of General Interest.

PIPE UNION.—J. B. AUSTIN, San Diego, Cal. The aim in this case is to provide a union more especially designed for joining adjacent main pipe ends and making provision for a branch connection, the union being arranged to permit convenient and quick assembling of the parts and fastening the same in place on the main pipe ends, to allow ready expansion and contraction of the pipe ends of the union parts, and to provide sufficient elasticity for the deflection of the pipes without danger of damaging the joint.

GATE FASTENER.—W. C. NEEL, Kinsley, Kan. In the present patent the purpose of the invention is the provision of novel, simple details of construction for fastening for a swinging gate, which will automatically lock the gate in closed condition when it is swung into engagement with a catch on a fence post or a like support.

FLOAT GAGE.—F. L. LANDER, Bangor, Me. In order to determine the amount of liquid remaining in a tank, particularly the gasoline tank of an automobile, Mr. Lander has devised the construction shown in the accompanying drawing. This gage will indicate the amount of gasoline with approximate accu-

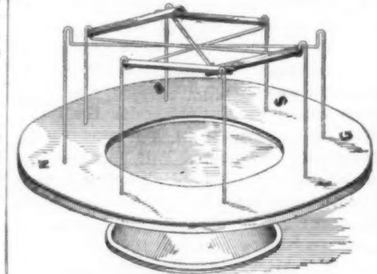


FLOAT GAGE FOR GASOLINE TANKS.

racy and will not be deranged or disordered by the motion of the automobile. It consists of a float well in which is a float secured to a tape that passes over a pulley at the upper end of the gage, and is secured to a counterweight. The tape is graduated to show the number of gallons of gasoline in the tank.

HORSESHOE.—E. F. BRANNON, Tacoma, Wash. An object here is to provide a shoe to which a rubber or other resilient tread member may be attached with ease. A further object is to provide novel means for holding the resilient tread member which prevents the latter from displacement, but which can be attached to the shoe without the use of screws, bolts, or other similar fastening devices.

CURRENCY RACK.—J. E. MOSS, Decatur, Neb. The object of the device shown in the accompanying engraving is to hold bills of different characters in superposed position, with each denomination by itself, so that access may be had easily to any particular bill or bundle of bills. The device consists of a



RACK FOR BUNDLES OF BILLS.

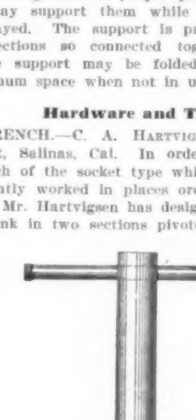
circular plate, with a central depression and a set of uprights located at regular intervals dividing the plate into sections. These sections are lettered N for national bank notes, G for gold certificates, etc. At the top of the standards are metallic strips which may be slid down to rest upon the the bundles of bills, and hold them in place.

COMPOSITION FOR STOPPING LEAKS.—J. M. JOHNSON, Lewiston, Me. This invention relates to a composition for stopping leaks in automobile engines, radiators, boilers, water tanks, water pipes, and various other devices which are subjected to the action of warm water or steam. There is to be no limit by the inventor to any particular use for the composition, as it may be employed in many relations in connection with various arts.

CONTAINER FOR OSTRICH PLUMES.—N. A. SELDIEN, New York, N. Y. This invention involves a support which may receive independently, a plurality of plumes, and hold them against displacement. The support may hold the plumes in proper position in a box, or may support them while they are being displayed. The support is preferably formed of sections so connected together that the entire support may be folded to occupy the minimum space when not in use.

Hardware and Tools.

WRENCH.—C. A. HARTVIGSEN, 318 Main Street, Salinas, Cal. In order to provide a wrench of the socket type which may be conveniently worked in places ordinarily inaccessible, Mr. Hartvigsen has designed a tool with a shank in two sections pivoted together and



IMPROVED SOCKET WRENCH.

with means for retaining the sections at different angles of adjustment. The socket section has a reversible ratchet mechanism, while the other section of the shank is provided with a handle which, when not in use, may be stowed in a central bore in the shank.

DOOR SECURER.—G. W. PACKARD, Deadwood, S. D. An object here is to provide a securer for insertion between a closure and the frame thereof, and adapted to removably hold the closure in a locked position. Use is made of a gripping bar for insertion between a closure and the frame thereof, with gripping means on the gripping bar, a locking bar mounted to slide on the gripping bar, and means on the locking bar and removably engaging the gripping bar to removably hold the closure in a locked position.

SAW HANDLE.—A. R. HULTIN, Prosper, Ore. The invention refers particuarly to saw handles of large saws which are detachably secured to the ends of the blades. An object is to produce a handle which can be very readily attached to the blade and which can be

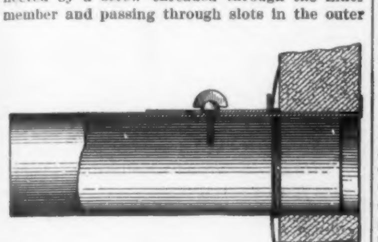
adjusted to different angular positions with respect to the blade.

REAMER.—S. M. STEVENS, Asheville, N. C. The invention pertains more particularly to that type of reamer attached to die stocks and the like, and adapted to ream pipe while the die stock is being removed from the pipe. It comprehends a self-feeding reamer slidably secured to a frame mounted on a die stock or the like, and adapted to ream a pipe after the pipe has been threaded by the die and the die is being removed from the pipe.

LOCK.—W. MEIER, New York, N. Y. This invention has reference more particularly to a device comprising a removable bolt adapted to secure in position a hasp used for fastening a door or the like, a movable member having means for holding the bolt in place at the inside of the door or other enclosure, and key-controllable means for actuating the movable member.

Heating and Lighting.

STOVE PIPE HOLDER.—GEORGE LEE, South Whitley, Ind. Mr. Lee's device for securing stove pipe in a chimney consists of two clamping members, one of which is disposed within the pipe, and the other on the exterior surface, the two members being connected by a screw threaded through the inner member and passing through slots in the outer



STOVE PIPE HOLDER.

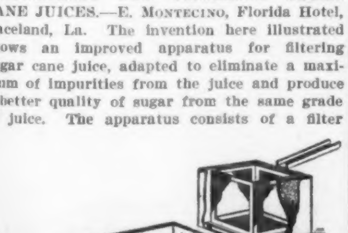
member and the stove pipe. When the screw is loosened sufficiently, the inner clamping member will drop, permitting the operator to insert the pipe into the flue hole; thereupon the screw is tightened to draw up the inner clamping member and to hold the clamping members against opposite sides of the chimney wall.

AUTOMATIC VALVE FOR WATER HEATERS.—W. E. KAY, Amherst, Ohio. The invention provides a valve by means of which, when the water is turned on and off, the gas will be automatically turned on and off simultaneously. The valve is so shaped that it seats perfectly. Moreover, it cannot stick in its seat, and fluctuations in the water pressure, incidentaly to the ordinary turning off and on of outlets in the water system, will not affect the valve.

RADIATOR.—G. M. AYLSWORTH, Collingwood, Ontario, Canada. The intention in this instance is to provide a radiator which will not take up any of the floor space in a room, and one which will not disfigure the walls, while it will permit a full flow of air from the room around the radiator and back again to the room. There is no danger of the entrance of smoke, dust, or ashes into the room.

Machines and Mechanical Devices.

APPARATUS FOR FILTERING SUGAR CANE JUICES.—E. MONTECINO, Florida Hotel, Raceland, La. The invention here illustrated shows an improved apparatus for filtering sugar cane juice, adapted to eliminate a maximum of impurities from the juice and produce a better quality of sugar from the same grade of juice. The apparatus consists of a filter



FILTER FOR SUGAR CANE JUICES.

box which delivers the juice to a set of open filter frames. By interposing the apparatus between the mill and the evaporator the necessity of skimming is dispensed with, since the juice is filtered before cooking, and there is no danger of discoloring the juice, by pressing out the coloring matter of the cane.

DROP STITCH AND LACEWORK MECHANISM FOR CIRCULAR KNITTING MACHINES.—A. N. AMES, Franklin Falls, N. H. The present invention relates to a circular knitting machine, and is embodied in a machine of that type known as the full automatic, in which the machine, once started, will knit a stocking complete; the transfer from the circular knitting for the leg and foot to the reciprocating knitting for the heel and toe and *vice versa* being accomplished by automatic pattern mechanism.

HORSESHOE CLIP FORMING MACHINE.—R. GROSDIDIER, Commercy, Meuse, France. This improvement consists essentially in subjecting the position of the horseshoe which is to be raised in forming the clip or welt, the said portion being previously heated, to a series of blows which follow each other in quick succession and are applied by means of cams or rollers moving at a great speed, while the direction in which the blows are dealt is gradually varied as in the case where the blows are dealt by hand.

PAPER HOLDER.—B. F. PEETS, N. W. THOMPSON, and H. S. MCDANEL, Moro, Ore. The invention on which the above inventors have obtained a patent relates to paper holders on typewriting machines, and involves a special construction of mechanism for advancing the paper, by giving the desired movement to a ratchet device on the copy roll, by the movements of the typewriter carriage.

MACHINE FOR TREATING SEWAGE, REFUSE, OR THE LIKE.—A. MARTIN and A. WHITCOMB, 35 Avenue Hoche, Paris, France. The present invention relates to a machine for the treatment of sewage, refuse or the like, and has for its object to break up the materials under treatment, to pulverize them, to work them up, and to dry them without permitting the escape of bad smells or odors.

PIPE LAYING MECHANISM.—B. H. SANDS, Tulsa, Okla. This invention pertains to a mechanism in the nature of a jack, adapted to force a pipe through the soil without digging a trench and disfiguring the surface. It provides a pipe-laying mechanism of the jack type with a point formed to cause a rotation of the pipe, thereby driving the pipe in a rectilinear manner.

Prime Movers and Their Accessories.

ROTARY ENGINE.—C. E. CLAPP, Buffalo, N. Y. The purpose here is to provide an engine arranged to utilize the motive agent economically and to the fullest advantage. To accomplish the desired result, use is made of a cylinder, provided on its inner surface with pockets, and a rotor in the said cylinder and provided with reaction nozzles, opening at their larger outer ends into the cylinder pockets, the inner ends of the nozzle being connected with a source of motive agent supply.

TEST OR PRIMING COCK.—B. MORGAN, Newport, R. I. The object of the inventor is to provide a priming cock arranged to permit convenient delivery of a quantity of gasoline or other explosive fluid into the combustion chamber of an internal combustion engine for testing or priming purposes, and subsequent closing of the cock to prevent escape of products of combustion by way of the cock.

Railways and Their Accessories.

SAFETY STEP FOR FREIGHT CARS.—A. C. NEALE, Leonard, Texas. The present invention has reference to improvements in safety steps for freight cars, and it comprehends, broadly, the production of a device upon which the brakeman or other train hand may step with safety prior to reaching the hanger, ordinarily employed, and the lowermost rung of the ladder on the car end.

Pertaining to Recreation.

BATHING BOAT.—M. J. UFFORD, Amenia, N. D. The purpose in this instance is to provide a boat having novel features of construction that enable its convenient and safe use as a sailing or row boat, and further, that adapt the boat as a float while bathing by either sex, affording safety and privacy for females while bathing in the open air, without necessitating the wearing of bathing suits.

Pertaining to Vehicles.

VEHICLE WHEEL.—G. B. LAMBERT, New York, N. Y. The invention has reference more particularly to a wheel which has a felly, a removable tire rim mounted upon a felly, a keeper for holding the rim in place, and means for moving the rim transversely of the felly at a point remote from the keeper, to cause the rim to swing on the felly as a fulcrum, at a part thereof adjacent to the keeper, so that the rim can be lifted clear of the keeper in removing the rim.

BRAKE FOR LOGGING CARTS.—P. JOHNSTON, Williams, Ariz. The invention is an improvement in logging carts or trucks and it has for an object to provide a novel construction whereby the truck may be braked in order to control the same going down hills. It is especially designed for use upon the two wheeled carts used in lumber woods.

AUTOMOBILE HORN.—G. BRAF, A. GIRARDI, G. OCCHINTO, and S. OCCHINTO, New York, N. Y. The purpose of this invention is to produce a horn by which the sound is amplified to a greater extent than in the conventional horn, and the tone improved in addition to constructing the horn so as to shed and exclude the greater portion of the dust and throw the sound waves to both sides as well as forwardly.

Designs.

DESIGN FOR A STOVE.—E. C. COLE, Chicago, Ill. The design in this instance is illustrative of a very symmetrical and gracefully ornamental stove of cylinder form. The dome is surmounted by an urn, and the base is supported by feet, the whole forming an original and pleasing effect.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

Kindly keep your queries on separate sheets of paper when corresponding about such matters as patents, subscriptions, books, etc. This will greatly facilitate answering your questions, as in many cases they have to be referred to experts. The full name and address should be given on every sheet. No attention will be paid to unsigned queries. Full hints to correspondents are printed from time to time and will be mailed on request.

(12363) A. H. asks: We are having a lot of trouble cooling down hot brass journals in an ice machine of 75 tons. When cooled by water they will heat up again as soon as the water is shut off, and the machine cannot be stopped. I have been advised to use sulphur and oil. Is the use of sulphur advisable or not? A. The bearings have probably been distorted by the heating, so as to need careful refitting. Sulphur and some other dry materials have been recommended as assisting in emergency to get a hot bearing cool, but it can hardly be advised for regular use. Graphite mixed with the oil may help, by filling up the low spots and by reason of its lubricating qualities, but refitting the brasses is the only permanent cure.

(12364) W. O. C. writes: It seems to me strange if there is no end or limit to space where all the planets are, and again it does not seem possible that it can be any stopping place to our worldly space. Where could I be enlightened a little on this at least? A. Much has been written upon space, but no conclusion has been reached which is universally accepted. A valuable article upon the subject is found in our SUPPLEMENT No. 1606, price ten cents, and the book "The Stars," by Simon Newcomb, price $2 postpaid, gives considerable data for forming an opinion upon it.

(12365) L. R. says: A wheel, say 4 feet diameter, revolves on a 2-inch shaft. If the size of shaft be increased to 4 inches, will this in turn increase the power necessary to drive the wheel? A. The leverage of the frictional resistance increases with the diameter of the shaft. Therefore the smallest axle that will support the load under the actual working conditions of good or bad lubrication, etc., without sticking or cutting will cause the least loss of work in friction. But if the 2-inch axle, for instance, is hard to keep lubricated and tends to give trouble, a larger journal will reduce the surface friction more than it will increase the leverage of the frictional resistance, and so it will make the wheel run easier.

(12366) L. H. M. asks: 1. A is rowing a rowboat. B holds a rope which is attached to a second boat. B contends that he is doing the work which makes the second boat move, and offers as proof the fact that there is a considerable strain on his arms. A says he is making the second boat move as well as the first. Please settle this. A. Do not confuse work with force. B is exerting force, but by the principles of physics he is doing no work, since he is not by any effort of his "causing the point of application to move in the direction of the force," that is, he is not pulling the tow nearer to himself. A is performing the work. 2. A man weighing himself holds a 12-pound weight by a handle; does he weigh 12 pounds more than ordinarily. If he exerts enough force to counteract the attraction of gravity for the weight, and lifts it up, is his weight now as usual? A. Demonstrate for yourself on the nearest platform scale that whatever weight you support, for instance your overcoat, adds to the reading of the scale. However, to reply to the question as you word it, the man himself weighs no more, and the weight no less, when he holds it. If he lifts the weight, giving it an acceleration of say one foot per second, he must exert an additional force of 12/32.2 or 0.37 force unit, or nearly 1/32 pounds additional to the 12 pounds necessary to resist gravity, the force exerted depending upon the acceleration, that is, he increase in speed of lift. Much information on all scientific subjects can be obtained in back numbers of the SCIENTIFIC AMERICAN SUPPLEMENT, which are furnished at the nominal price of ten cents each. Our extensive subject catalogue of the articles or our catalogue of scientific books will be sent free upon request.

(12367) L. J. B. says: If two projectiles of equal weight were fired from guns having the same muzzle velocity—one projectile vertically, the other at the most favorable angle to cover the greatest horizontal distance—which would reach the greater distance from the gun muzzle? A. Neglecting the resistance of the atmosphere, the projectile fired vertically would go to the height $\frac{v^2}{2g}$, while if fired at an angle of 45 deg. it would land at a horizontal distance of $\frac{v^2}{g}$, or twice as far from the gun. v = the velocity, in feet per second, at the muzzle, and g is the acceleration due to gravity, 32.2 feet per second.

NEW BOOKS, ETC.

ELECTROTECHNICS. By John Henderson, D.Sc., F.R.S.E., A.M.I.E.E. New York: Longmans, Green & Co., 1909. 165 pp. Price, $1.20 net.

This is the third of a series of physical and electrical engineering laboratory manuals. The book has been prepared particularly for use as a syllabus of electrical engineering in the City and Guilds of London Technological Institutes, and represents a three years' course. The first part representing the first year, takes up elementary electrical engineering; while the second and third parts deal with direct current and alternating current, as taught in the ordinary grade course. It is a book of experiments, primarily, and suggests work for the students to do at home during the week preceding the laboratory course.

BERMUDA, PAST AND PRESENT. By Walter B. Hayward. New York: Dodd, Mead & Co., 1910. 16mo.; 239 pp. Price, $1.25 net.

In this book all the vivid colors of Bermuda are painted for the benefit of the American traveler who seeks a respite from frost and snow by migrating to the coral-bound land of sunshine, flowers, delightful scenery, and perennial spring. "Bermuda, Past and Present" is not only an accurate and comprehensive guide to the islands, but it deals with their history, literary associations, recreations, government, and resources. Moreover, it is an important contribution to American history, inasmuch as it brings into relief and throws new light upon the many dramatic episodes of the Revolution and the civil war, in which Americans and Bermudians participated. This is perhaps the most satisfactory of all the books on Bermuda which have ever come under the writer's notice.

LEADING AMERICAN MEN OF SCIENCE. Edited by David Starr Jordan. New York: Henry Holt & Co., 1910. Price, $1.75.

This book contains short and sympathetic biographies of fifteen leaders in American science, each one written by a man in some degree known as a disciple. The only noteworthy omission is the name of Benjamin Franklin, whose biography will be published in another volume in the same series. In an excellently worded preface Dr. Jordan points out that the volume constitutes a part of the scientific record of the republic for one hundred years. It is a history of struggles in a new country, without great libraries, great museums, or great universities, and therefore represents self-help and self-reliance to a greater degree than would be shown in a parallel volume in any other land. The fifteen men of science who are discussed are: Benjamin Thompson, Count Rumford, by E. E. Slosson; Alexander Wilson, by Witmer Stone; John J. Audubon, by Witmer Stone; Benjamin Silliman, by D. C. Gilman; Joseph Henry, by Simon Newcomb; Louis Agassiz, by C. F. Holder; Jeffries Wyman, by Burt G. Wilder; Asa Gray, by J. M. Coulter; J. D. Dana, by W. N. Rice; S. F. Baird, by C. F. Holder; O. C. Marsh, by G. B. Grinnell; E. D. Cope, by Marcus Benjamin; J. W. Gibbs, by E. E. Slosson; Simon Newcomb, by Marcus Benjamin; G. B. Goode, by D. S. Jordan; Henry A. Rowland, by Ira Remsen; W. K. Brooks, by E. A. Andrews.

PANAMA AND THE CANAL TO-DAY. An Historical Account of the Canal Project From the Earliest Times, With Special Reference to the Enterprises of the French Company and the United States. With a Detailed Description of the Waterway as it Will be Ultimately Constructed. Together With a Brief History of the Country and the First Comprehensive Account of Its Physical Features and Natural Resources. By Forbes Lindsay. Boston: L. C. Page & Co., 1910. 53 illustrations. Price, $3.

The work before us is a valuable addition to the steadily growing literature upon the Panama Canal. This great work is treated under two main sections, Part I. being devoted to the canal, and Part II. to the country. The first section opens with a readable chapter entitled "The Dream of the Strait," and the historical side of the subject is pursued under the various captions of "Practical Projects," "The Panama Railroad," "The French Enterprise," and "The Transfer of the Canal." The four concluding chapters of Part I. are devoted to the description of the physical and engineering elements of this stupendous undertaking, and the layman will find here a clearly written and easily understandable account of the methods employed in carrying through the work, and of the physical aspects of the canal as they will appear at the date of its completion. Part II., devoted to the country, throws a flood of light upon a subject which is much less known and understood than its intrinsic historic and modern interest demands. The half-tone illustrations are numerous and well chosen for their purpose, and they cover the topographical features of the country, the natives and their homes and life, and some excellent views of the present condition of the engineering work. The book evidences a careful study of the subject, and is so readably written that the interest is sustained throughout.

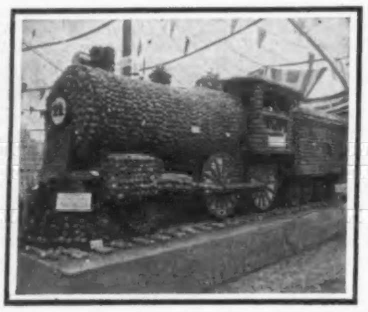
Curiosities of Science and Invention

"Apple Locomotive"

CALIFORNIA has long been classed among the great fruit-producing regions of the United States. In the matter of apple culture, Sonoma County, Cal., is considered the "banner" county of the State.

Very recently an "apple show" was held in the little city of Sebastopol, Sonoma County, lasting a week. The exhibition was one of the largest held on the Coast, and was attended by immense crowds of visitors.

The most peculiar and attractive feature of the entire fair was a huge, "life-size" locomotive, built wholly of very large, choice apples. The framework was of wood, and over this were placed the apples. The total length of the engine, including the cab and tender, was nearly twenty-six feet, and it stood nine feet high from the "apple roadbed" up to the top of the smokestack. There were a bell, sand chamber, headlight, cow-catcher, and all of the necessary accessories of a regular railway engine—even to the number—"22."


Apple locomotive.

The apple engine was a duplicate—so far as number, proportions, and dimensions are concerned—of the faithful old freight locomotive that has so long hauled all of the produce of the Sebastopol region to Santa Rosa over the Northwestern Railway.

This unique exhibit involved considerable time and no small expense. It is needless to add that it was the center of public admiration and curiosity, and was awarded the very highest premium.

Motoring on Runners

SOME time ago we illustrated an automobile driven by an air propeller. Recently this machine has been mounted on runners and has been driven at high speed over the snow-covered roads and the ice of the river and creeks around Indianapolis. The differential of the machine is not connected with the drive shaft. In fact, there is no drive shaft, as a chain combination connects the motor and the 8-foot propeller in the rear. There is only a six-inch clearance between the wooden propeller and the ice, and for this reason, and also because it frightens horses, it cannot be used much on the roads.

The Austrian snow automobile shown herewith suggests another method of motoring over snow and ice. A simple stanch frame mounted on runners carries an air-cooled motor-cycle engine, which is geared to a spiked driving wheel. The latter digs into the ice or snow and propels the sled at a high rate of speed, owing to the fact that the weight carried is very light.


An Austrian type of snow automobile.


An automobile mounted on skates and driven by an air propeller.

The "Longer Pier" Controversy at New York

We have drawn attention editorially to the fact that the huge dimensions which are being adopted for the latest steamships are not due to any mere whim of the steamship companies, nor chiefly to motives of advertisement, but that they follow a strict economic law, according to which the larger the single unit of transportation, the less the cost per unit of freight or per passenger carried. The War Department takes the stand that it is inadvisable that the pierhead lines at New York harbor encroach any farther upon the available channel width of the Hudson River, which they claim is at present none too wide for the heavy traffic which passes up and down this waterway. The question, then, becomes one of expediency. Shall we slightly reduce the channel width of the Hudson River, and permit the development of the ocean steamship to follow its own natural laws without restriction, or shall we arrest this development for the sake of preserving the Hudson River channel at its present width?

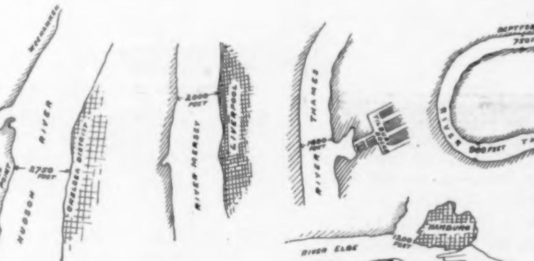
To take a 100-foot strip from each side of the channel, or preferably, a 200-foot strip from the Manhattan side, would be to reduce the Hudson River from 2,750 to 2,550 feet, a reduction, say, of about seven and a half per cent.

Now the importance of preserving the width of the channel may be fairly determined by comparing the conditions at New York with those of other leading harbors of the world. If the accommodations at New York are more restricted than at other ports, the serious character of the proposed encroachment becomes very evident. If, on the other hand, the available sea room for through traffic and for the maneuvering of big ships be much larger than at the other ports, this question of advancing the pierhead lines becomes of relatively less importance.

With a view to presenting the facts of the case clearly, we have prepared the accompanying plan, showing the conditions at five leading ports of the world; from which it will be seen that the Hudson River section of New York harbor, with its width of 2,750 feet, offers unrivaled facilities. The great port of Liverpool has but 2,000 feet of width; London, but 1,600 feet; while the great port of Hamburg has available, with its 1,200 feet of clearance, less than fifty per cent of the channel width available along the western shore of Manhattan Island.

We have spoken above of the question of the pier length at New York controlling the future development of large ocean steamships. That the port of New York will exercise this control is due to the fact that it is the natural gateway for the passenger traffic between the old and the new world. Nature has so willed it; and history has proved that no artificially created conditions can divert the great lines of steamship travel from those points of arrival and departure, which the geographical lay of the land has determined as being the best suited for the purpose.

It has been contended by those who are opposed to the lengthening of the piers that these giant steamships will have to seek some other terminal, such, for instance, as the new city docks at South Brooklyn. It is sufficient answer to this to say that the traveling public demands that it embark and land as near the heart of New York city as possible. It was in answer to this demand that the Pennsylvania Railroad Company blasted out three million cubic yards of rock in the center of Manhattan Island; erected a vast terminal station; and drove its tubes below the Hudson River; spending nearly one hundred million dollars on the enterprise. For the same reason the New York Central Railroad is spending a vast sum on its new station at Forty-second Street. It is the wish of the traveling public that the passenger steamship companies receive and disembark their passengers as near to these railroad terminals and to the hotel district of the city as possible. The argument has been presented that if passengers be disembarked at South Brooklyn, some five miles from the hotels and railway terminals of Manhattan, where they would have to take a subway journey to reach the desired center, they might just as well be landed at Jamaica Bay, Montauk Point, or Boston. The length of the journey is not so much the objection as the fact that any railway journey whatever has to be undertaken at the close of a long sea voyage before reaching the desired destination.



Plan showing the width of fairway at the world's leading seaports.

The Current Supplement

The opening article of the current Supplement, No. 1831, which is from the pen of the Paris correspondent of the Scientific American, discusses the new line of electric subway now in operation in Paris.—Just at the present moment, when the competition in naval armaments has pressed to the very utmost the output resources of the great armament firms in England, Germany, and the United States, the views of Sir William White, as they appear in an interesting paper on the subject of battleship armaments to the Society of Naval Architects and Marine Engineers in New York, are of more than usual interest. Sir William's excellent paper is summarized.—In an article entitled "Some Notes on Telephony," Mr. H. Harrison brings together concisely such fundamental and general information pertaining to telephony which is not readily available to the technical man not directly engaged in this phase of engineering activity.—Prof. Joseph W. Richards's excellent summary of the modern accomplishments of electro-chemistry is concluded.—One of the greatest facts that modern astronomy has revealed is that our whole solar system is now journeying toward the constellation Lyra. This greatest of unsolved problems of astronomy is simply discussed by Mr. Arthur K. Bartlett.—The Paris correspondent of the Scientific American writes on a project which has recently been proposed to establish a navigable connection between Paris and the English Channel, so as to convert the French capital into a seaport, and allow vessels up to 3000 tons to unload freight at the docks.—Mr. Harold Long, author of "Common Weeds on the Farm and Garden," writes on "The Destruction of Weeds by Chemical Means."

Electricity

Portable Wireless Telegraph Sets for Use in Battle.—The Navy Department has purchased several portable wireless telegraph sets for use in battle. The sets have a range of about twenty miles. When clearing for action, the regular aerial of the vessel will be taken down, and the portable set installed instead. The portable sets may also be used to advantage by landing parties.

Surveying the Water Power of Japan.—Our Consul at Yokohama writes that the Japanese government is investigating the water supply of the country. This investigation is to be most thorough, and for the collection of data, thirteen offices have been established. In the meantime, no further concessions are being granted by the government, owing to the fact that it has been discovered that many of the concessions already given were secured for purely speculative purposes.

Electricity Brought Down by Rain.—A series of observations made in India by B. C. Simpson are published in a recent number of the *Electrical Review and Western Electrician*, which show that electricity brought down by rain may be positive or negative. The total amount of positive electricity recorded was 3.2 times the total quantity of the negative electricity, and the period during which the positively-charged rain fell was 2.5 times that of the negatively-charged fall. Treating the charged rain as equivalent to a vertical current of electricity, the current densities were generally less than 4×10^{-16} amperes per square centimeter, but on a few occasions greater current densities, both positive and negative, were recorded.

Purchase of Electric Power.—The current used by the electric locomotives in the Detroit River tunnel is purchased from the Detroit Edison Company, and is stepped down from 4400 volts to 650 volts direct current by a sub-station. "The energy," says the *Electrical World*, "is purchased on a maximum-demand as well as a kw.-hour basis, which makes it necessary for economical operation to eliminate as far as possible excessive peaks from the incoming lines. A storage battery has been installed to take care of the fluctuations of load, and the regulation devices are such that the first 800 amp. are taken from motor-generator sets; then the battery takes care of the load from 800 amp. up to 8360 amp.; that is, the battery takes 7560 amp. Anything above this figure is again taken from the motor-generators. The maximum load is 9100 amp. When this load is being carried the motor-generator sets would be delivering 1540 amp. (their full load rating) and the battery would be supplying 7560 amp."

Biplane Guy Wires as Antennæ.—The principal obstacle to wireless telegraphy from aeroplanes, particularly biplanes, which have a mass of guy wires, consists in the fact that these wires absorb most of the energy and act as a shield for the antenna wire. After experimenting for a long time with different methods of stringing a separate antenna, Mr. E. M. Horton has hit upon the idea of using these guy wires as his antenna, while for the ground he employs the motor of the aeroplane. Experiments with a machine thus equipped, in the building of the United States Aeronautical Reserve, in this city, have proved most successful, messages having been received from various stations throughout the city, and even from ships at sea, despite the fact that the aeroplane was located on the first floor of the building and was not connected with any form of antenna on the roof. A very light equipment is used, the total weight of which is but 65 pounds, although a 6-inch spark coil is employed. The coil is fed by a 12-volt storage battery of 50 ampere hours, weighing but 40 pounds. The guy wires are connected in series, and give a total length of about 800 feet.

Engineering

Cost of War.—According to the calculations of Edmond Théry, the French economist, the cost of maintaining the armed peace of Europe during the last twenty-five years was about thirty billion dollars. During this time there has been constantly withdrawn from productive industry an average total of about four million men.

New Ships for the Navy.—The House Naval Affairs Committee has voted for the construction of two dreadnoughts, two colliers, eight destroyers, and four submarines. The new battleships may carry twelve 14-inch guns and reach 28,000 or 30,000 tons displacement. It is recommended that the new battleship "New York" be constructed at a private yard, the naval constructors having estimated that this will cost $1,700,000 more if it is built at the Brooklyn navy yard.

Battleship "Texas" a Target.—In the annual target practice of the Atlantic fleet, which will be held on the southern drill grounds off Hampton Roads during the spring, the "Texas," the first battleship to be built for the United States navy, will be used as a target. She will be moored in shoal water off the capes of Chesapeake Bay, and high-explosive shells will be fired against the hull and superstructure at ranges of from eight thousand to ten thousand yards.

Novel Railroad Bridge.—The new highway and railroad bridge to be built across the Willamette River, Portland, Oregon, which will weigh ten tons to the foot, will carry a highway and street car tracks on the upper deck, and the Harriman railroad lines on the lower deck. The latter will normally remain in a raised position for the passage of smaller shipping, and will be lowered only for railroad trains. When lofty sailing vessels pass through, the entire draw span will be raised on towers to the necessary height.

Record Railway Run.—A special train on the Pennsylvania Railroad recently made the run from Washington to New York, 226.8 miles, in 3 hours and 55½ minutes, or, excluding delays for change of locomotives, etc., in 3 hours and 48½ minutes. This is 1 hour and 4½ minutes faster than the regular express service schedule calls for. Excluding delays for change of locomotives, the 90.5 miles from Philadelphia to New York was made at the average speed of 69 miles an hour. The 80.5 miles from West Philadelphia to Newark was run at an average speed of 72 miles an hour.

Triple Gun Turrets.—The Italians and the Russians will be the first to use triple gun turrets (turrets containing three guns) on their new ships. In a recent article in our columns, it was argued that the triple turret was the best because it gave the heaviest concentration over the widest arc of broadside fire. The objection to the triple is that a single shot, well placed, might put three guns out of commission at once. There is safety in wide distribution of the armament. The smallest risk to the guns and the maximum accuracy and speed of fire are obtained when each gun is mounted in a single turret.

Failure of a Large Oil Reservoir.—The huge concrete oil reservoir, with a capacity of one million barrels, recently completed at San Luis Obispo, Cal., and illustrated in the SCIENTIFIC AMERICAN of December 10th, 1910, recently failed by the rupture of the containing concrete wall. The tank was 601 feet in diameter, inclosed by a wall tapering from 6 inches at the top to 3 feet at the bottom, and 20 feet in height. A section of the wall 125 feet in length spread outwardly, the rupture occurring in a horizontal and vertical direction. The outer earth embankment, or fire wall, served to hold the oil until it was piped to another reservoir.

Aeronautics

An Aviator Punished at Law.—Van Heulen, an aviator who accidentally killed a woman at Issy, has been sentenced in Paris to pay a fine of $10 for carelessness, and $1,000 damages to the woman's husband. Another aviator, Baillod, was sentenced at Limoges to a month's imprisonment and a fine of $75 for killing a girl at an aviation meet.

New Aeroplane Prizes.—In addition to the prize of $500 for a flight of a mile or more from shore, terminating with a landing upon the deck of a vessel, which was offered a short time ago by the United States Aeronautical Reserve, this organization also offers $1,000 for the first aeroplane that leaves the deck of a vessel, makes a 10-mile flight, and lands upon the deck of the same vessel again. A prize of $500 is offered for the first wireless message sent from an aeroplane by a member of the Reserve and received by another member 10 miles away. Mr. E. E. Harbert, the president of the Illinois Aeroplane Club, has offered a prize of $1,000 to the first aviator who will carry him as a passenger from Chicago to St. Joseph or Michigan City, a distance over water of 62 miles.

The Money Side of Aviation.—That aviation is not only an enjoyable sport, but a profitable business as well, may be gathered from statistics recently published by a French automobile journal. According to that paper, the amount distributed in prizes in 1910 was 4,705,500 francs. This figure does not include special sums paid to aviators for their appearance at different meetings. Louis Paulhan, with a total of 430,000 francs, won during the last two years, received under contract 100,000 francs a month extra for his flights in America. The list of aviators who in 1910 won 100,000 francs or more includes Paulhan, 350,000 francs; Latham, 289,500 francs; Morane, 289,300 francs; Grahame-White, 257,000 francs; Leblanc, 147,000 francs; Signor, 156,500 francs; Chavez, 156,000 francs; Capt. Dickson, 131,000 francs; Wynmalen and Mr. Sopwith, 100,000 francs.

A Practical Test of the Aeroplane Scout.—On January 16th, at the San Francisco meet, Lieut. Geo. E. M. Kelly of the 13th Infantry, U. S. A., made an 18-minute flight with Walter Brookins in his Wright biplane for the purpose of determining the feasibility of scouting by aeroplane. He could see for a considerable distance by the aid of his binoculars, but he failed to locate a small body of troops that had left the Presidio Military reservation a few hours before. He made sketches, drew maps, and took six photographs of the surrounding country. This is the first time that an aeroplane has been used for scouting purposes in America, and it recalls to mind the frontispiece published in our issue of December 19th, 1908, in which the Wright machine was depicted performing this service.

Bomb Dropping Experiments at San Francisco.—On January 15th a number of important tests were made at bomb dropping at San Francisco. Lieut. Myron Crissey, of the Coast Artillery, dropped a special shrapnel bomb from a height of 550 feet when flying in a Wright biplane driven by Parmalee. Lieut. Crissey succeeded in dropping the bomb with a considerable degree of accuracy. He believes that it will be a comparatively simple matter to hit an object the size of a battleship from a height of 3,000 feet. The bomb he used in the experiment consists of a very thin shell of brittle white cast iron. It was fitted with a percussion cap and loaded with bullets and black powder. Its weight was about 8 pounds. From the height it was dropped the bomb tore a large hole in the ground and scattered its contents within a radius of 50 yards. This is the first time that an actual bomb has been used in such an experiment.

Science

New Members of the Zoological Society.—The Zoological Society of London has elected former President Theodore Roosevelt one of its corresponding members; also the following foreign members of the society: B. Basu, Calcutta; J. M. Doctor, Bombay; Dr. R. Dohrn, Naples; Prof. Ludwig von Graff, Graz University; W. H. Osgood, Washington, D. C., U. S. A.; Mr. H. Pam, Caracas; Mr. R. B. Woosman, Navrobi; Prof. E. Lonnberg, Stockholm; and S. H. Scudder, Cambridge, Mass.

Madame Curie Defeated.—Madame Curie was defeated for election in the Academy of Sciences. Branly received one vote more than she. There can be no question of the value of M. Branly's contributions to physics, and above all, to the art of wireless telegraphy, nor of his fitness to sit in the Academy as one of its most distinguished members. Yet one cannot but feel that Madame Curie's defeat was due entirely to her sex. We have sufficiently commented on this matter in our editorial columns. Branly was the inventor of the coherer, which was such an important factor in the early stages of wireless telegraphy, although it is now hardly ever used, except for small experimental stations.

Solar Radiation.—With the improvement of apparatus for measuring the intensity of solar radiation, this important element of climate will be more and more widely observed at meteorological stations. Statistics of solar radiation are much needed in connection with many researches, geophysical, meteorological, and biological. We are therefore glad to learn that the Weather Bureau has already taken the initial steps toward a complete pyrheliometric survey of the United States, though the consummation of this project is hardly to be looked for in the next few years. As a beginning, five stations are to be equipped with the new Marvin pyrheliometer. A self-registering pyrheliometer is a desideratum that Prof. Marvin hopes to realize before long. It is expected that we shall ultimately have charts showing the average intensity and total amount of solar radiation for all parts of the United States, just as we now have charts of the temperature, rainfall, etc.

The Variability of Rainfall.—A simple and convenient mode of expressing the variability of rainfall during a long period of years, which was used by A. Angot in 1883, in his studies on the climate of Algeria, has recently been made the subject of a special investigation by Dr. G. Hellmann, and named by him the "variation-quotient of annual rainfall" ("Schwankungs-Quotient der jährlichen—Niederschlagsmenge.") This "variation-quotient," which promises to be widely used in comparative climatology, is the ratio of the maximum to the minimum yearly rainfall, during the period for which observations are available. For example, a comparison of the rainfall records of 34 stations in northern Germany extending over a period of fifty years shows that their average variation-quotient was 2.2; i. e., on an average the wettest year had 2.2 times as much rainfall as the driest. The smallest variation-quotient found in this region was 1.8 and the largest 2.8, and in general it is found that this ratio does not vary much among the stations within a given climatic province. The smallest variation-quotient likely to be encountered anywhere in the world is about 1.5. As uniformity in the amount of rainfall from year to year is advantageous for many practical matters in which rainfall is a factor—especially agriculture—Hellmann has classified as "very favorable" a quotient under 2.0; "favorable," 2.0-2.4; "rather favorable," 2.5-2.9; "rather unfavorable," 3.0-3.9; "unfavorable," 4.0-4.9, and "very unfavorable," 5.0 and upward.